Jan. 21, 1964 R. R. COLBURN 3,118,266

RIDING TYPE POWER MOWER WITH FLOATING BLADES

Filed Feb. 2, 1961 3 Sheets-Sheet 1

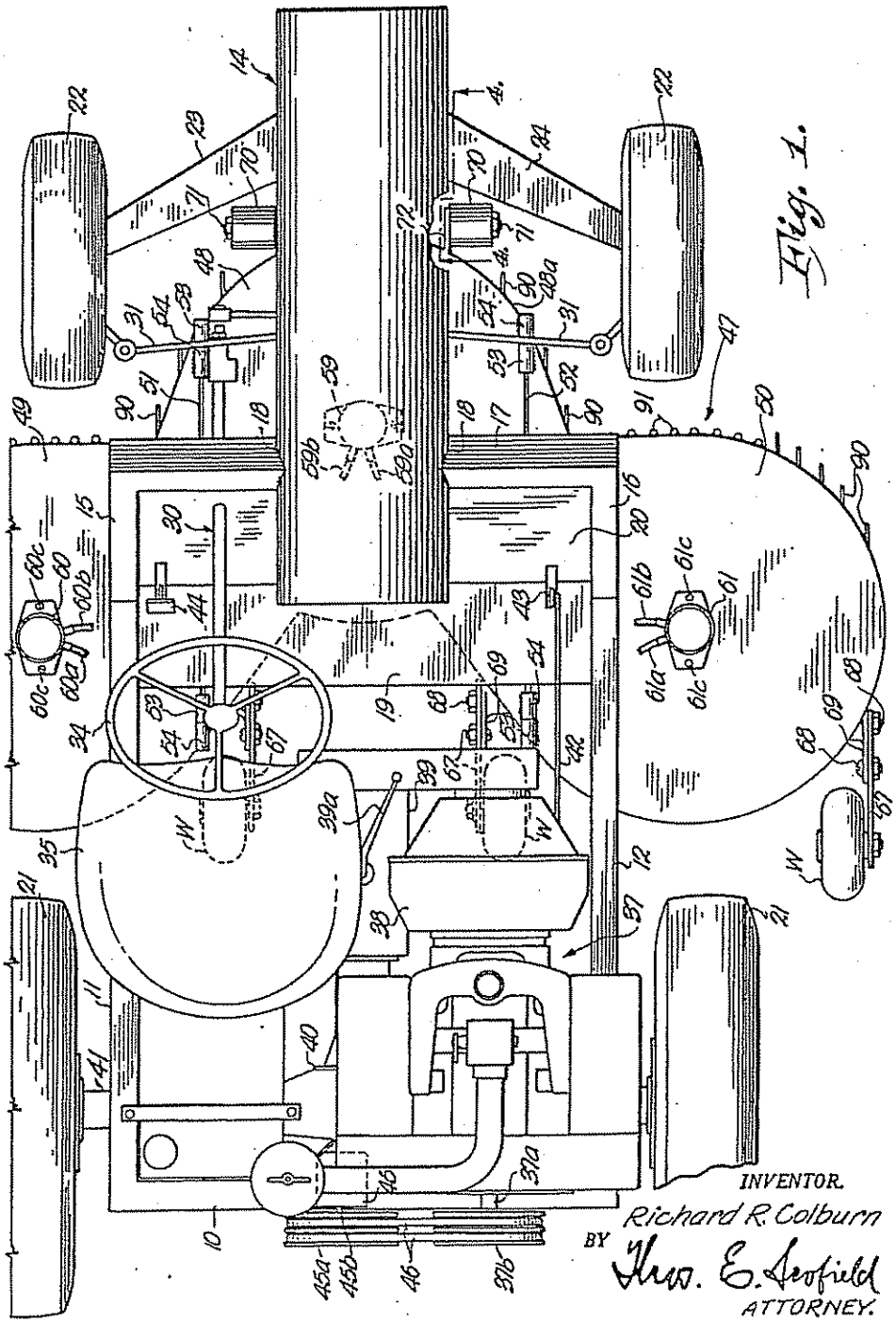

Fig. 1.

INVENTOR.
Richard R. Colburn
BY Thos. E. Scofield
ATTORNEY.

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Filed Feb. 2, 1961 3 Sheets-Sheet 2

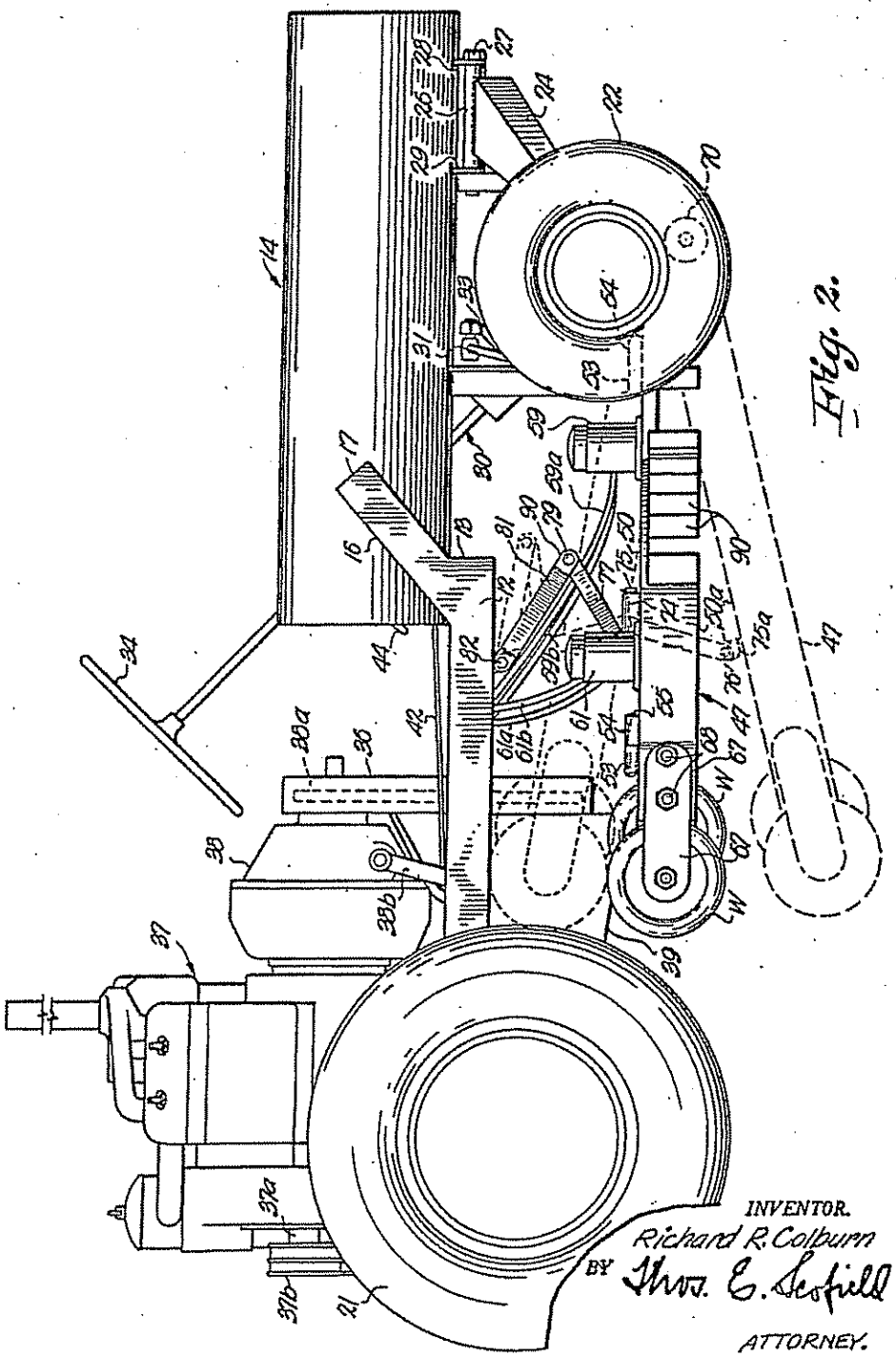

Fig. 2.

INVENTOR.
Richard R. Colburn
BY Thos. E. Scofield
ATTORNEY.

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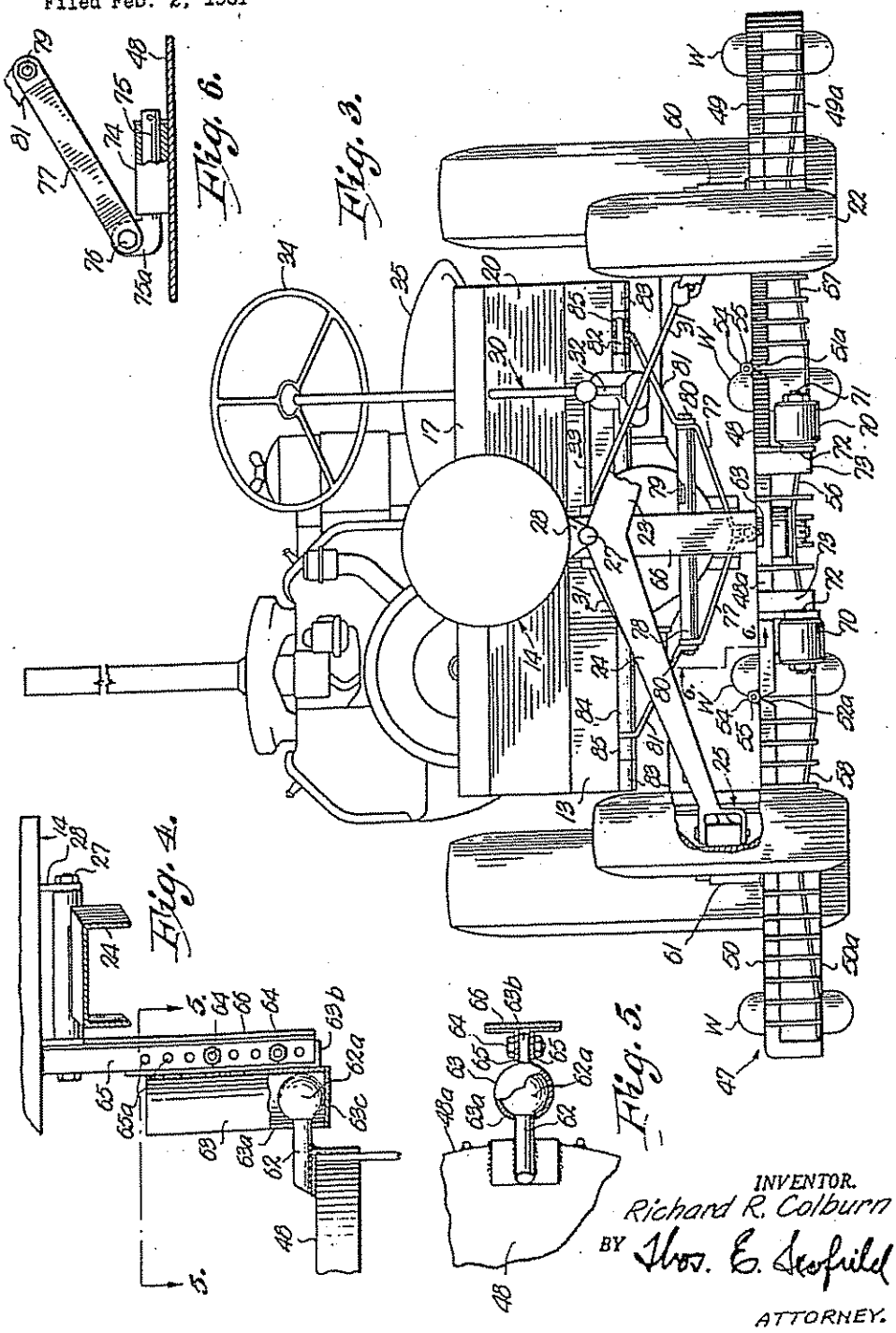

Fig. 6.

Fig. 3.

Fig. 4.

Fig. 5.

INVENTOR.
Richard R. Colburn
BY Thos. E. Scofield
ATTORNEY.

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3,118,266
RIDING TYPE POWER MOWER WITH FLOATING BLADES

Richard R. Colburn, 5507 N. Palo Christi Road, Phoenix, Ariz.

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12 Claims. (Cl. 56—25.4)

This invention relates to power operated self-propelling mowers and refers more particularly to a riding type mower having particularly advantageous features in connection with obtaining optimum floating and independent motion of the blades relative to the ground and the chassis of the unit in order to obtain evenness of cut and to prevent scalping and the like.

One of the important objects of the invention is to provide a riding type mower which is compact and easy to operate, yet in which the mower housing is supported for substantially free floating movement relative to the chassis and thus is capable of closely following changing ground contours so as to maintain the blade or blades at substantially constant spacing from the ground. In my prior Patents 2,801,510 and 2,869,304 I have disclosed riding type mowers directed toward the general purpose herein contemplated. However, the present invention represents in certain respects marked improvements over the arrangements therein disclosed, not only from the standpoint of increased freedom and independent floating action for the blades, but also in making possible a much wider cut or swath in a single pass of the unit.

A further object of the invention is to provide a riding type power mower which is singularly advantageous for use in obtaining a wide but smooth and even cut on sharply changing and inclined topography. While the structure herein disclosed is capable of embodiment in a standard size unit, say one providing a 24 inch to 50 inch swath, it finds its most valuable employment in connection with swaths 60 inches or greater. Heretofore work of this type has been handled by accessory mowers adapted to be connected with or ganged behind conventional tractors. The present invention substitutes for this sometimes cumbersome and relatively expensive arrangement an integrated riding unit which is operable at a fraction of the horsepower supplied by conventional tractors and which in sum is cheaper to build and to operate.

Still another object of the invention is to provide a riding type mower of the character described in which the drive to the blades is unaffected by the rise and fall and rocking motion of the latter as they are shifted according to ground contours during use. It is a feature of the invention in this respect that the blades are driven through hydraulic means, with the unit so designed that the reservoir component of the hydraulic system serves also as a part of the structural frame of the unit. The utilization of hydraulic drive for the blades has eliminated many of the problems attendant upon maintaining a continuous belt drive in combination with free floating mounting of the cutter blade, particularly where it is attempted to drive blades which are capable of movement relative to one another.

A further object of the invention is to provide a multiple blade mower in which all blades are supported in such fashion that they are all capable of rising and falling movement relative to one another.

Another object of the invention is to provide a riding type mower of the character described in which the supporting wheels for the chassis can be given a greater span than heretofore thought possible while still preserving the contour following or floating action of the mower housing. This feature is particularly valuable in providing mowers which will obtain an even cut on relatively steep side inclines and yet which will be stable enough to present little danger of overturning.

A further object of the invention is to provide a suspension and guide mechanism for under-mounted mower housing which makes it possible to cut wide swaths with contour following action, and yet in which the mower is maintained in straight line tracking relationship with the carrier vehicle despite the existence of severe lateral forces on the housing.

Other and further objects of the invention together with the features of novelty appurtenant thereto will appear in the course of the following description.

In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith, and in which like reference numerals indicate like parts in the various views:

FIG. 1 is a top plan view of a mowing unit embodying the invention, fragmentary portions of one housing section and the rear wheels being broken off and other parts broken away for purposes of illustration;

FIG. 2 is a side elevational view showing the near side of the unit as viewed in FIG. 1;

FIG. 3 is a front end elevational view of the unit, parts again being broken away for purposes of illustration;

FIG. 4 is an enlarged fragmentary sectional view taken generally along the line 4—4 of FIG. 1 in the direction of the arrows;

FIG. 5 is a sectional view taken along line 5—5 of FIG. 4 in the direction of the arrows; and

FIG. 6 is a fragmentary sectional view taken along line 6—6 of FIG. 3 in the direction of the arrows.

Referring now to the drawings, the chassis of the unit is best seen in FIGS. 1, 2 and 3. The frame of the chassis comprises an open rectangular rear portion made up as interconnected structural members defining a rear crossbar 10, laterally spaced forwardly extending side rails 11 and 12 and a front crossbar 13 (see FIG. 3). The bars and rails may conveniently be formed as channel sections welded at their ends to one another to provide a rigid structure lying substantially in a horizontal plane. Rigidly connected with the front crossbar 13 and extending forwardly thereof is the cylindrical tank 14. The tank 14 serves as an integral structural part of the frame of the vehicle. Upwardly and forwardly inclined side rail extensions 15 and 16 join with an upper crosspiece 17 which is cut away to receive the tank, the cut ends being joined to the tank by welds 18. Preferably a floor section 19 bridges between the rails 11 and 12, the floor section merging at its forward end with an upwardly inclined fire wall or dash 20 which is supported at its edges by the side rail extensions 15 and 16 and the front crosspiece 17. The wall 20 is likewise cut out to accommodate the tank 14, being welded thereto along the edge of the cut.

The frame is supported by the rear wheels 21 and front wheels 22. The front wheels are mounted at the outer ends of the swept back legs 23, 24 of a front wheel yoke. Conventional steering knuckles, a typical one of which is seen generally at 25 in FIG. 3, serve to connect the wheels with the ends of the yoke. The upper end of the yoke is connected centrally to the underside of tank 14 through the medium of a bearing sleeve 26 which is journaled on a pin 27. The pin is secured to the tank by depending brackets 28, 29 which are welded or otherwise secured to the tank. Thus the yoke is free to rock relative the frame of the unit about the axis defined by pin 27.

The steering mechanism for the front wheels is conventional, being schematically exemplified in the drawings by the steering shaft or column 30 and a pair of tie rods

31 which extend outwardly to connect with the knuckles. The lower end of shaft 30 is connected with the tie rods through the steering arms 32 and 33. Since the details of the steering mechanism play no part in the invention, further description is believed unnecessary.

The upper end of the steering shaft is fitted with the steering wheel 34 which is located in operating proximity to the seat 35. The seat 35 is supported on the frame by suitable bracing (not shown) including the usual leaf spring (not shown). It will be noted that both the seat 35 and steering shaft or column 30 are offset to one side of the fore and aft center line of the frame.

The power source for the unit comprises the engine 37 which is coupled through a clutch 38 and chain drive 38*a* to a transmission 39 which terminates in a differential 40 forming a part of the rear axle 41. The chain drive is contained within housing 36. I have not attempted to show the details of the drive components since they are available on the market. For my purposes I have chosen a Wisconsin V4 30 horsepower engine and a Willis clutch transmission and rear end. The clutch is provided with an arm 38*b* which is operably connected through link 42 and lever arm 43 to the operating pedal 44. It will be understood that pedal 44 and lever 43 are keyed to a common cross shaft (not shown) so that depression of the pedal causes displacement of the lever in a direction to disengage the clutch. The transmission is provided with the usual shifting hand lever 39*a* positioned to be accessible from the seat. On a commercial machine a brake will also be included, but again this forms no part of the invention, and consequently has not been shown.

Located at the rear of the engine 37 is a power take-off including the shaft 37*a* and double track sheave 37*b*. The power take-off is drivingly connected with a hydraulic pump 45 through the medium of belts 46 which are trained around a second double track sheave 45*a* which is secured to the shaft 45*b* drivingly connected with the pump. The pump 45 is secured to the rear crossbar 10 of the frame in any desired fashion.

Located beneath the frame and between the front and rear wheels is the mowing mechanism, the main element of which comprises the housing or blade mounting platform 47. The plan of the housing is generally similar to that shown in my earlier Patent 2,869,304, being adapted for the mounting of three blades which have serially overlapping cutting paths as the unit is propelled forwardly.

In the preferred embodiment of the invention, the housing 47 is subdivided into three sections; the central section 48 having the rounded generally semi-circular leading edge 48*a*, and two flanking and generally trailing side or wing sections 49 and 50, respectively. The wing sections 49 and 50 form continuations of the central section and are hingedly connected therewith along axes which are parallel with the longitudinal axis of the chassis, that is, the normal path of straight line advance. The line of division between the wing section 49 and central section 48 is indicated at 51, and between the central section and the wing 50 at 52. The hinge connection is provided at two locations along each line, each hinge comprising two aligned hinge barrels 53 and 54 secured respectively by welding to the adjoining housing sections and connected by a common pin 55. The four hinges are best seen in FIG. 1. It will be noted from FIG. 3 that the confronting edges of the adjoining sections of the housing are relieved along the line of juncture (as at 51*a* and 52*a*) in order to permit limited downward movement of each wing section 49 or 50 relative the central section 48. The extent of relief should be so limited as to cause binding before the tips of the outermost blades reach the underside of the central section 48.

As has been earlier mentioned, each section of the housing carries its own blade, the individual blades being identified respectively by reference numerals 56, 57 and 58. Each blade is drivingly connected by suitable shafting to a corresponding hydraulic motor 59, 60 or 61 which

is secured to the top of the housing section which carries the particular blade, as by bolts 62. The hydraulic motors are of conventional commercially available construction. I have selected for the purposes of the invention 2500 r.p.m. 5 horsepower motors. Each motor is connected in the usual fashion with the pump by means of an input line 59*a*, 60*a*, or 61*a*, and has a return line 59*b*, 60*b*, or 61*b*.

The tank 14, in addition to functioning as a structural part of the chassis, serves as the reservoir for hydraulic fluid. The return lines 59*b*, 60*b* or 61*b* are connected with the reservoir in the usual fashion employed in hydraulic systems. To preserve clarity in the drawings I have not shown the complete piping system as it is believed that this will be evident to those skilled in this art. Obviously the pump 45 has its inlet side connected with the tank 14 so as to draw hydraulic fluid therefrom as needed and its discharge connected with the respective input lines to the motors through the usual pressure compensating flow controllers and a manually operable two-way valve permitting selected diversion of the fluid directly from the pump to the reservoir when it is desired to discontinue operation of the motors.

The input and return lines of the respective motors are of flexible construction so that the mower housing sections can rise and fall and rock relative to the frame and one another without interrupting the power supply to the motors.

Taking up now the arrangement for supporting the mower housing and its sections 48, 49 and 50, and referring first to the central section 48, the forward end of this section is provided with a forwardly extending connector member 62 (FIG. 4) terminating in a ball-like head 62*a*. The ball 62*a* is confined for vertical and rotational movement in a hollow cylindrical guide member 63 having a vertical slot 63*a* running substantially from the bottom to top and permitting upward displacement of the connector member with respect to the guide. The guide member 63 has a vertical flange 63*b* on the side opposite from the slot. This flange is provided with a pair of spaced apertures adapted to receive bolts 64. The flange is received between a pair of spaced legs 65 which extend from and are secured to a depending bracket 66 in turn secured at its upper end, as by welding, to the bottom of tank 14. The legs 65 of the bracket are provided with a plurality of spaced apertures 65*a* and it will be evident that the elevation of the guide 63 relative to the tank can be adjusted by removing the bolts, moving the guide up or down, and reinserting the bolts.

The bracket 66, guide 63 and connector 62 combine to provide the front suspension for the mower housing. The bottom 63*c* of the guide serves as a bottom stop for the ball 62*a*. The vertical location of the guide on the bracket determines the normal spacing of the lead end of the housing from the ground. However, it will be evident that should any upward force be applied to the lead end, the housing is free to lift relative to the guide, the ball moving upwardly in the guide. The ball and guide cylinder arrangement makes for complete freedom of the housing to simultaneously rock and rotate, except as limited by engagement of the connector arm 62 with the edges of the guide slot 63*a* or of the connector or housing with the guide, and this is true at any position of the ball within the guide cylinder. In other words, up and down rocking movement of the housing is limited only by the spacing of the housing from the guide and diameter of the ball, while there is no limit in the connection itself on rotation of the housing about an axis passing centrally through the connector member 62 and the center of the ball.

The rearward portions of the housing sections 48, 49 and 50 are supported at the desired elevation relative the ground by the ground engaging wheels W, of which in the preferred embodiment there are four. Each flanking or wing section 49 and 50 is provided with a wheel W located near its outer extremity while the center section 48 is

provided with two wheels W, one on each side of the center line and preferably closely adjacent the lines of division 51 and 52 between the sections. The wheel mountings are substantially identical, each having a plate 67 to which the wheel is journaled and which is connected as by bolts 68 to a bracket 69 integral with and extending from the periphery of the housing. It may be desired in some instances, particularly where the unit is expected to negotiate sharp turns, to caster the wheels as generally disclosed in my Patent 2,801,510.

The forward end of the central housing section 48 is provided on opposite sides of its longitudinal center line with a pair of ground engageable rollers or small diameter wheels 70. As best seen in FIG. 3, the rollers 70 are journaled on horizontal axles 71 which are connected at their inner ends with mounting brackets 72 extending forwardly of the housing. The brackets 72 are in turn welded or otherwise affixed to narrow depending section 73 integral with the housing. The rollers 70 are so located and dimensioned as to normally be spaced slightly above the plane of engagement of the front and rear wheels of the chassis with the ground, and thus on level ground they will be out of contact with the ground. However, it will be evident that bumps or hillocks of lesser width than the span of the front wheels, and in the path of the roller 70, will engage same to apply lifting force to one or the other or both, and thus to the housing. The suspension connection previously described permits the housing to be displaced relative the frame in response to such forces, thus maintaining the blade at the desired cutting level with respect to the irregularity in ground contour.

The longitudinal center line of the central housing section 48 is substantially stabilized in a fixed plane relative to the frame through the medium of a link mechanism which serves to connect the central housing section with the frame at a point to the rear of the front suspension means. Referring to FIGS. 2, 3 and 6, it will be observed that located on the center line and secured to the top of the housing is a bearing sleeve 74 having its axis aligned with the center line. Rotatably journaled in sleeve 74 is a shaft or pin 75 having at its rearmost end an enlarged head 75*a* which is apertured to rotatably receive a cross-pin or bolt 76. The head is offset slightly from the axis of the shaft 75 so as to permit substantial rotation of the housing relative to the shaft without interference between the top of the housing and the head or parts connected therewith.

The bolt 76 serves to pivotally connect to the shaft 75 the lower ends of a pair of converging symmetrical legs 77. The upper ends of legs 77 are spaced apart by a tube-like spacer 78 which has journaled therein an elongate pin 79 having threaded ends adapted to receive nuts 80. Journaled on the ends of pin 79 inside the nuts are the lower ends of a second pair of downwardly converging symmetrical legs 81. The upper ends of the legs 81 are in turn journaled on a cross-shaft 82 which spans between and is affixed by brackets 83 to the undersides of the side rails 11 and 12 of the frame. The legs are restrained against longitudinal movement on the cross-shaft 82 by the central elongate tube spacer 84 and the shorter spacers 85 disposed between the legs and brackets 83.

As is believed evident from the foregoing description and the drawing, the pivotally interconnected pairs of legs 77 and 81 serve to form a foldable and expansible link mechanism between the frame and central housing sections which prevents sidewise or lateral movement of the housing relative to the frame, yet permits the housing (1) to rise and fall relative to the chassis, (2) to rotate with respect to a longitudinal axis defined generally by the shaft 75, and (3) to tilt in either direction with respect to axes transverse to the normal path of advance. The upper legs 81 may be regarded as the upper link of the link mechanism and the lower legs 77 as the lower link. The wide spacing between the points of connection of the upper legs 81 with the cross-shaft 82 coupled with the downwardly converging arrangement of the legs, provides a substantially rigid link structure which allows optimum floating movement of the housing while still affording the requisite resistance to lateral displacement of the housing with respect to the frame in the event of forces exerted on the housing which would tend to shift it away to either side of the normal line of advance.

It should perhaps at this point be noted that if the tolerances in the front suspension and rearward link mechanism are exceedingly close, then it is advantageous to see that the center of the ball 62*a* is in line with and intersected by the axis of the link shaft 75. However, usual manufacturing tolerances permit of some variation from this condition.

Returning now to further consideration of the mower housing 47 and the makeup of its individual sections, it will be observed that wherever the leading edge is curved, I have provided spaced parallel vanes 90 through which grass passes into the housing as the mower advances. The vanes assist in preventing the grass from being pushed toward the outside of the curvature and in feeding it substantially upright into the cutting zone of the blade. The vanes have leading edges which extend slightly forwardly of the perimeter of the housing in the areas in which they are located. The usual spaced protector pins 91 can be utilized on the straight portions of the housing which are transverse to the line of advance since grass deflection is no real problem here.

While for the most part the blades are not shrouded by the housing, nevertheless, it is advisable to provide a depending shroud as at 49*a* and 50*a* on the wings 49 and 50 to guard against stones and other objects being thrown with great force laterally or to the rear of the housing outside the rear wheels.

The manner of operation of the invention, has, for the purposes of clarity and explanation of the structure, been incorporated largely in the foregoing description and should be readily apparent therefrom and from the drawings.

As the unit advances over the terrain, the blades 56, 57 and 58 are driven from the hydraulic pump 45 and will sever the grass in the usual fashion in a swath having a width substantially equal to the full span of the housing. The relatively widely spaced front wheels 22, by virtue of being located in close proximity to the leading edges of the wing sections 49 and 50 of the housing and to the sides of the central section 48, will serve to lift the frame as humps or hillocks are encountered and with it the lead portion of the housing through the front suspension connection 62, 63. At the same time, the rear ground engaging wheels W individually support the sections of the housing and follow ground contours, the front suspension connection and floating link mechanism permitting free rocking of the central section about longitudinal and transverse axes and the hinge connections between the wing sections 49 and 50, and the central section, permitting relative movement between the individual sections.

The elevated ground engageable rollers 70 disposed between the front wheels serve to lift the forward end of the housing relative to the chassis as elevations between the front wheels are encountered, and it will be evident that full rocking freedom of the housing is preserved in the lifted position due to the manner of construction of the front suspension connection.

The link mechanism represented by link members 77, 81 insures that the housing will continue to track in a straight line even though only one of the outer wheels W contacts a rise. In this situation a moment is created tending to swing the entire housing about a vertical axis through the front suspension. However, the link mechanism resists this moment. Obviously, too, the link mechanism still permits rocking to take place under these cir-

cumstances because of its pivotal connection with the housing.

The freedom provided in the front suspension connection for vertical displacement of the housing with respect to the chassis also makes possible the provision on the unit of means for lifting the housing to a non-operating position when it is desired to travel the unit along a highway or road. If desired, such means can be included on the frame in the form of winches and chains connected with the respective housing sections.

From the foregoing it will be seen that this invention is one well adapted to attain all of the ends and objects hereinabove set forth together with other advantages which are obvious and which are inherent to the structure.

It will be understood that certain features and subcombinations are of utility and may be employed without reference to other features and subcombinations. This is contemplated by and is within the scope of the claims.

As many possible embodiments may be made of the invention without departing from the scope thereof, it is to be understood that all matter herein set forth or shown in the accompanying drawings is to be interpreted as illustrative and not in a limiting sense.

Having thus described my invention, I claim:

1. In a riding type power operated mower, the combination of a chassis including a frame and front and rear wheels supporting said frame, power drive means mounted on said frame and connected with at least one of said wheels for propelling said chassis, a normally substantially horizontal mower housing positioned beneath said frame between said front and rear wheels, at least one horizontal rotary cutting blade mounted within said housing, a front suspension connection between said frame and said housing normally supporting the forward end of said housing from said frame above and free of contact with the ground, said suspension connection including structure operable to permit elevation of said forward end relative to said chassis and mounting said housing for independent rocking movement relative to said frame and wheels about axes running longitudinally and transversely with respect to the frame, ground engageable means connected with said forward end of said housing and normally spaced above the ground, ground engaging means connected with said housing and supporting same at points remote from said axes whereby to follow ground contours, guide link mechanism connecting said housing with said frame at points spaced rearwardly of said suspension connection and operable to confine the longitudinal axis of rocking movement to a normally substantially vertical plane running substantially longitudinally of the chassis, and means providing a flexible power drive from said chassis to said blade.

2. In a riding type power operated mower, the combination of a chassis including a frame and front and rear wheels supporting said frame, power drive means mounted on said frame and connected with at least one of said wheels for propelling said chassis, a normally substantially horizontal mower housing positioned beneath said frame between said front and rear wheels, at least one horizontal rotary cutting blade mounted within said housing, a first pivotal link member depending from said frame and pivotally connected at its upper end with the frame for confined swinging movement of the free end of the link member about a first link axis disposed transversely of the frame, a second link member extending upwardly from and pivotally connected with said housing for movement of its free end relative to said housing about a second link axis parallel with said first link axis, means pivotally connecting the free ends of said link members with one another, suspension means connecting the forward portion of said housing with and normally supporting it from the frame with the blade spaced above the ground level, a ground engaging means on the housing and engaging the ground at points spaced rearwardly of the suspension means, said suspension means constructed to permit rocking movement of said housing about an axis transverse to the frame.

3. In a riding type power mover, the combination of a chassis including a frame and front and rear wheels supporting said frame and defining a ground engaging plane, a normally substantially horizontal mower housing positioned beneath said frame between said front and rear wheels, at least one horizontal rotary cutting blade mounted within said housing, a suspension means connecting the forward portion of said housing with said frame and operable to permit limited up and down displacement of said front portion relative to the frame, said suspension means further constructed to permit rocking movement of said housing relative thereto about an axis parallel to the normal path of advance of the chassis and an axis substantially normal to the path of advance during said displacement, ground engageable means on the forward portion of the housing spaced above said ground engaging plane but operable to lift said forward portion independently of said wheels in response to pressures applied thereto, ground engaging means connected with and supporting said housing to the rear of said suspension means, and link mechanism connecting said housing with said frame at points spaced rearwardly of said suspension means and operable to permit said rocking movement and displacement of said housing but confining said housing against sidewise movement with respect to said frame.

4. The combination as in claim 3 wherein said housing comprises at least two sections, each said section having a rotary cutting blade mounted therein, and means hingedly connecting said sections with one another for relative movement about an axis parallel with the normal path of advance of the chassis.

5. The combination as in claim 4 wherein each said section includes said ground engaging means.

6. In a riding type power mower, the combination of a chassis including a frame and front and rear wheels supporting the frame, a normally substantially horizontal mower housing positioned beneath said frame between said front and rear wheels, at least one horizontal rotary cutting blade mounted within said housing, a front suspension element connnected with the frame and depending therefrom toward the forward portion of the frame, a suspension connector member affixed to said housing, means connecting said connector member with said suspension element whereby to permit up and down movement of the connector member relative to said suspension element and simultaneous rocking movement of said housing about axes running respectively longitudinally of the chassis and crosswise of the chassis, and a foldable and extensible link mechanism connecting said housing with said frame rearwardly of said connector member, said link mechanism operable to confine said housing against sidewise movement relative to said frame while permitting said rocking movement about all said axes.

7. The combination as in claim 6 including stop means operating to limit the downward movement of said connector member to a position in which said blade is spaced above the plane of engagement of said wheels with the ground.

8. The combination as in claim 6 including ground engageable means connected with the forward portions of said housing and operable to cause lifting of said housing independently of a change in attitude of the frame.

9. The combination as in claim 6 wherein said link mechanism includes a sleeve affixed to said housing and aligned generally with the normal path of advance of said chassis and a shaft journaled in said sleeve whereby to permit rocking movement of said housing relative to said link mechanism.

10. In a riding type power mower, the combination of a chassis including a frame and front and rear wheels supporting the frame, a normally substantially horizontal mower housing positioned beneath said frame between said front and rear wheels, at least one horizontal rotary

cutting blade mounted within said housing, a sleeve affixed to the top of said housing and extending longitudinally with respect to said chassis, a shaft journaled in said sleeve, a pair of interconnected link members including an upper link member and a lower link member, means pivotally connecting the lower link member with said shaft for movement with respect thereto about a first axis normal to the shaft axis, means pivotally connecting the upper link member with the frame for movement with respect thereto about a second axis parallel to said first axis, suspension means connecting the forward portion of the housing with the frame, and ground engaging means connected with said housing and supporting said housing at points remote from said axes whereby to follow ground contours and cause rocking movement of said housing with respect to said axes.

11. The combination as in claim 10 wherein said suspension means is constructed to permit upward displacement of said housing relative to said frame in response to an upward force on said housing.

12. The combination as in claim 10 wherein said housing comprises three sections in the form of a central section and two opposed laterally extending wing sections, said sleeve affixed to said central section, and each wing section hingedly connected with said central section, each section having mounted therein a rotary cutter blade, and ground engaging means on each section.

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June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 1

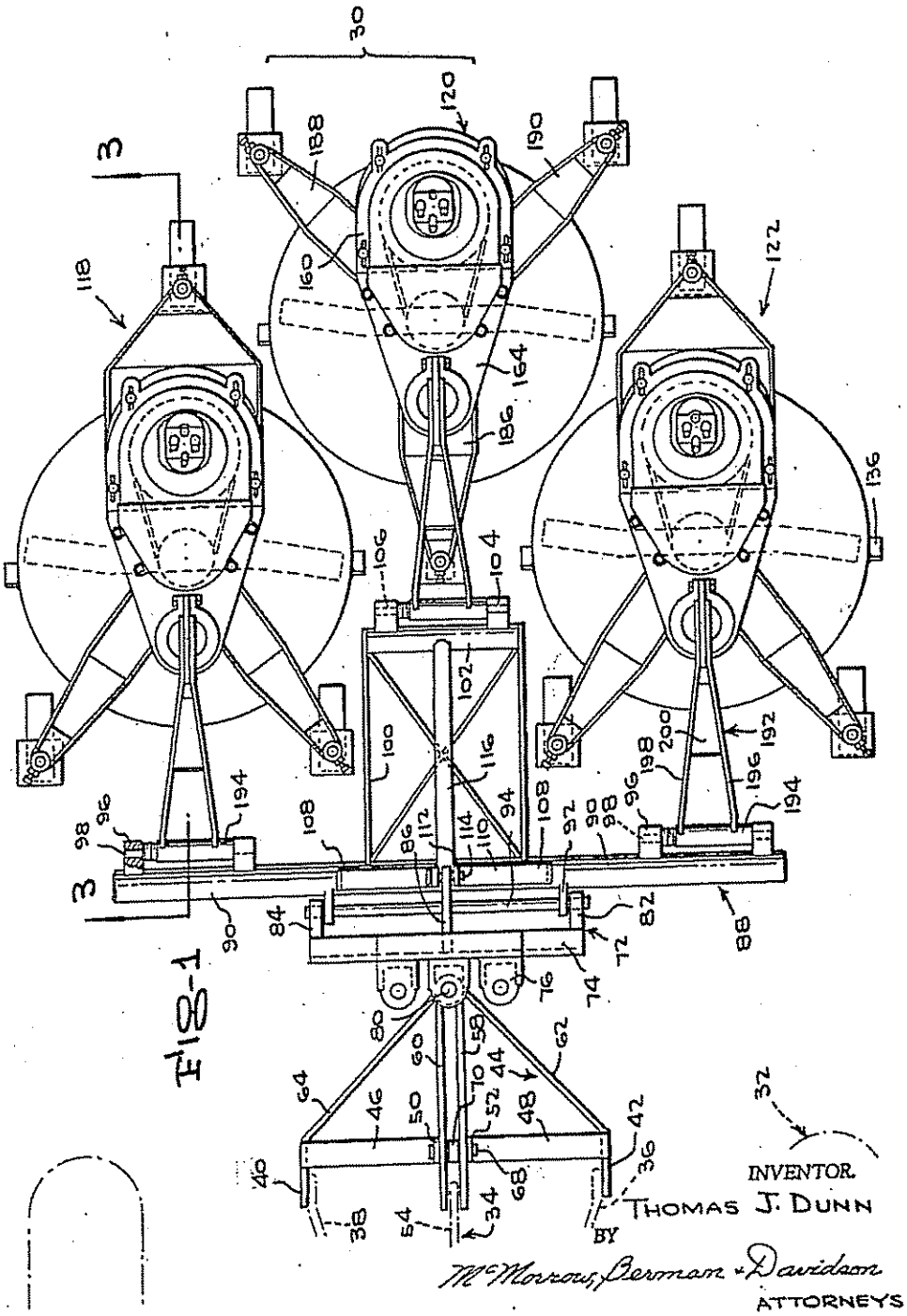


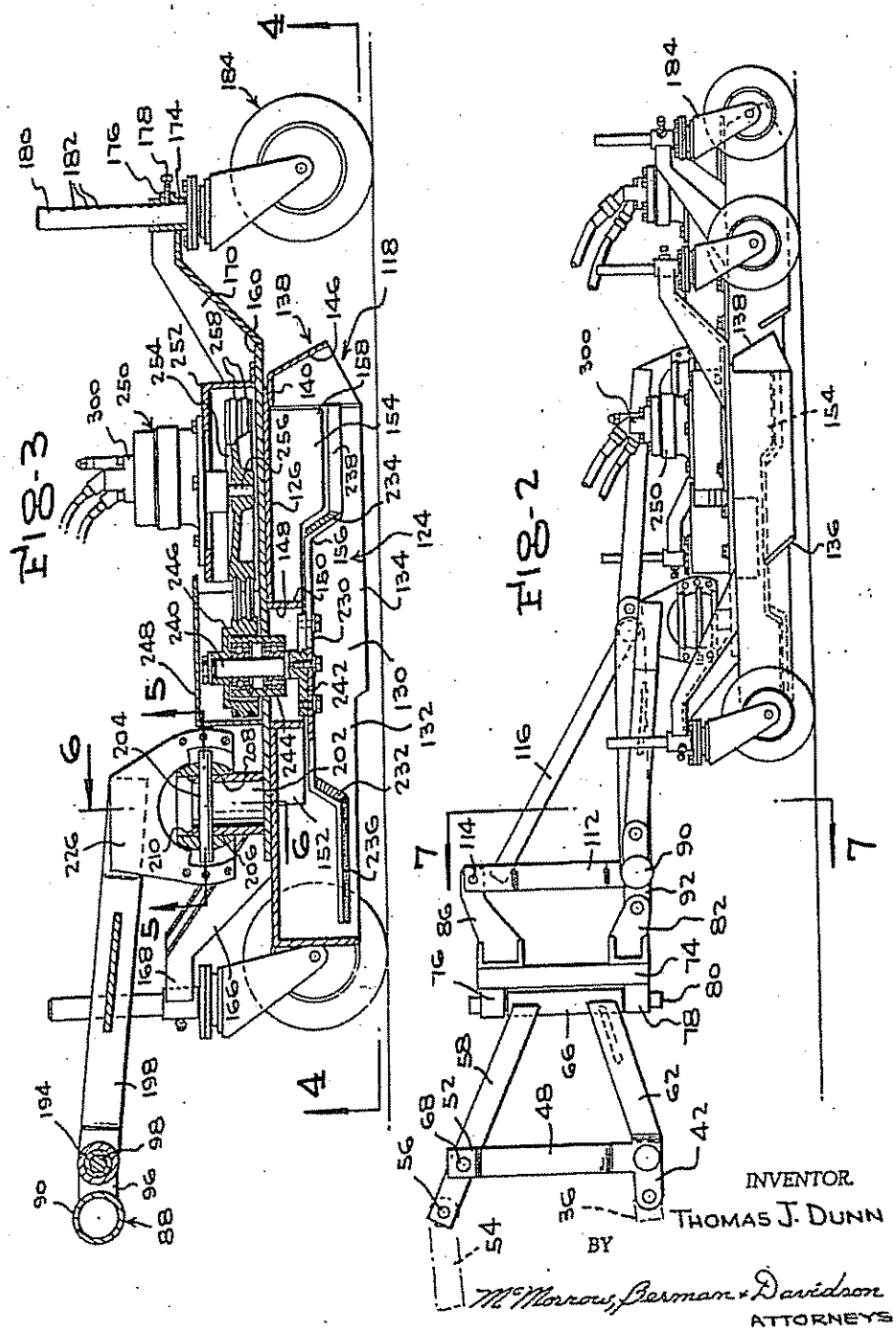
FIG-1

INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 2



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MOWING APPARATUS

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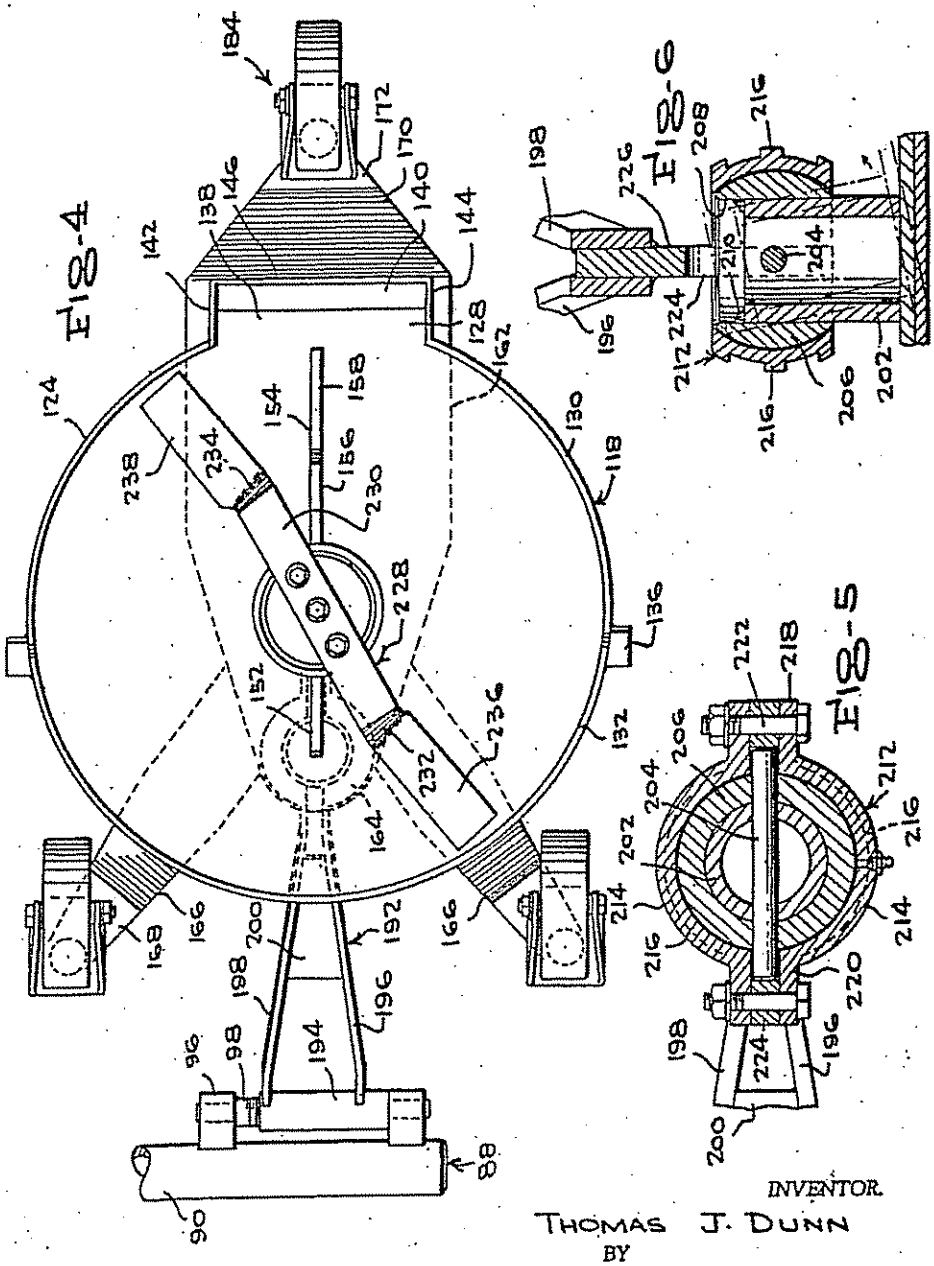


INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 4

FIG-7

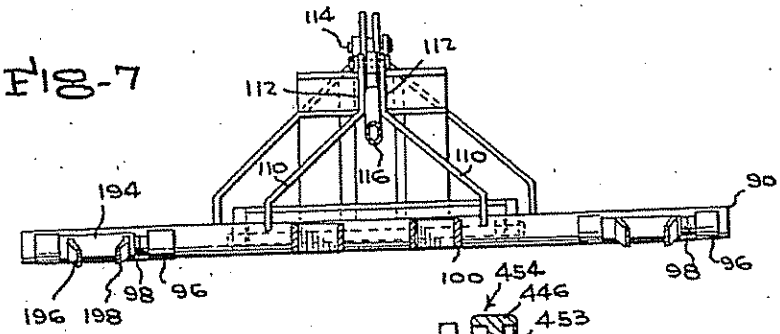


FIG-15

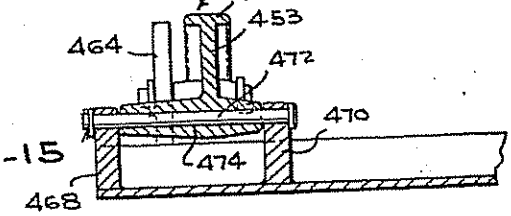


FIG-14

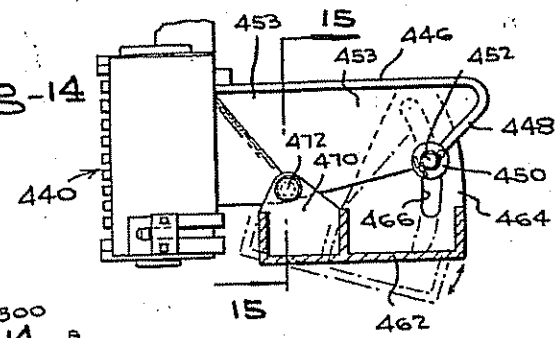
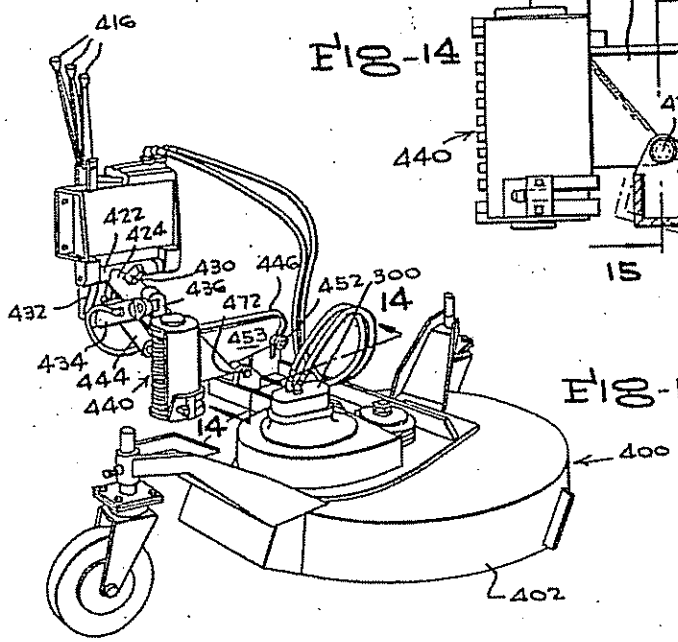


FIG-11



INVENTOR.
THOMAS J. DUNN
BY

McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 5

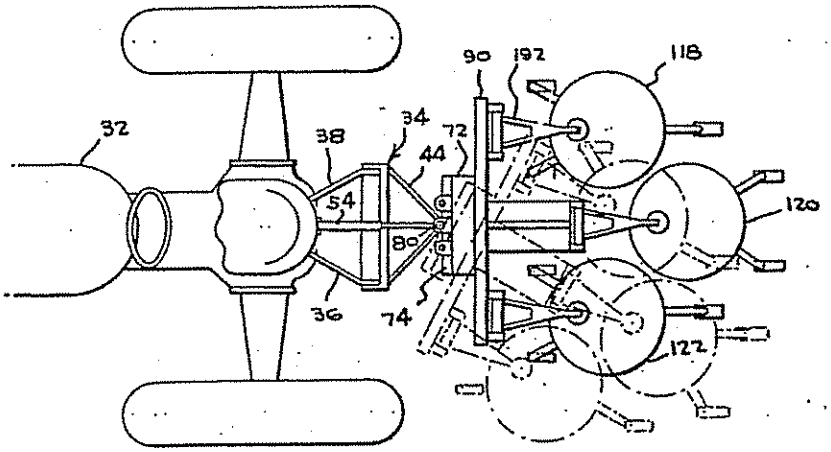


Fig-8

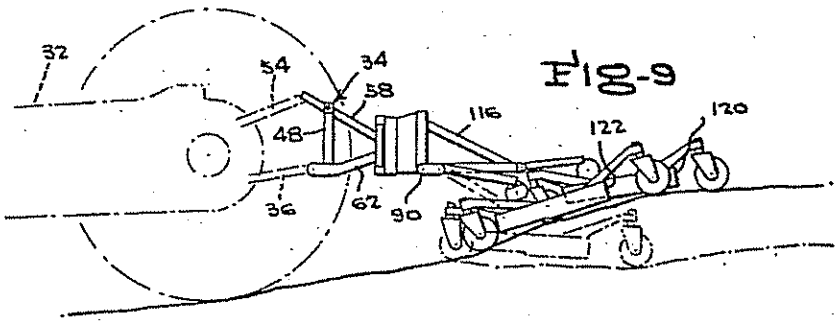


Fig-9

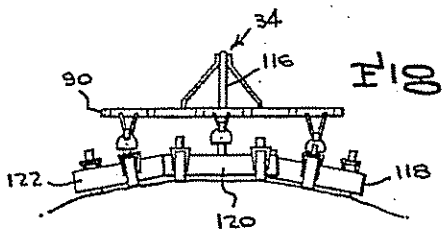


Fig-10

INVENTOR.
THOMAS J. DUNN
BY

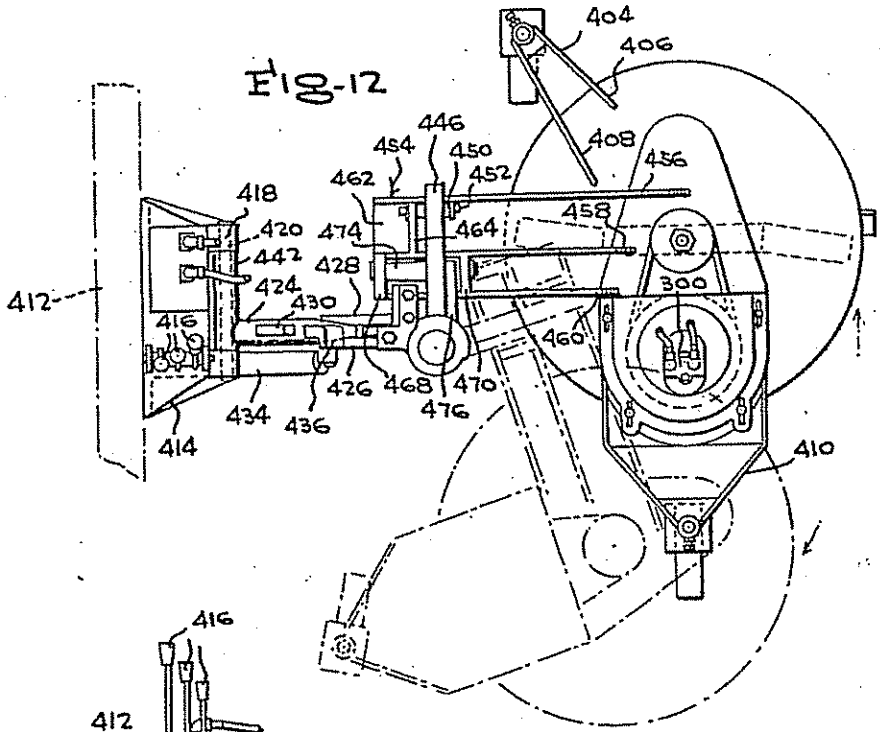
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 6

Fig-12



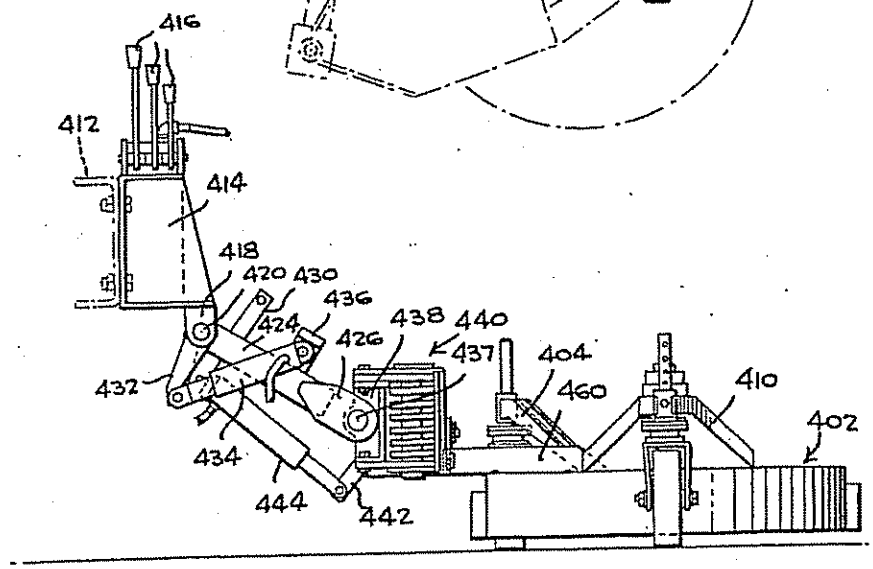


Fig-13

INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 7

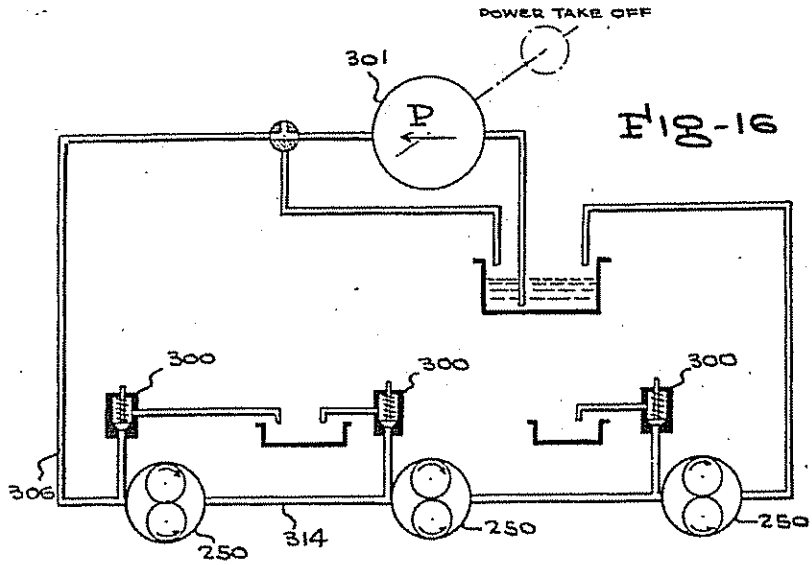


Fig-16

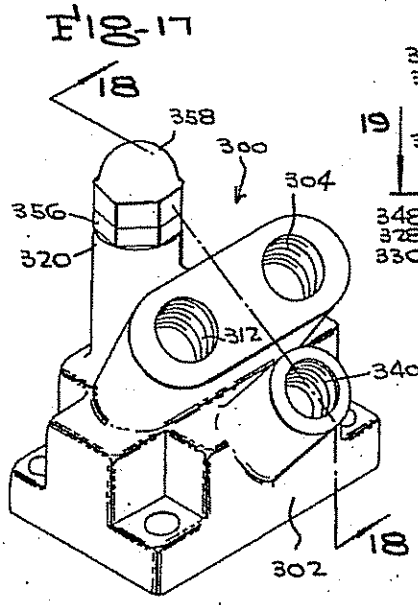


Fig-17

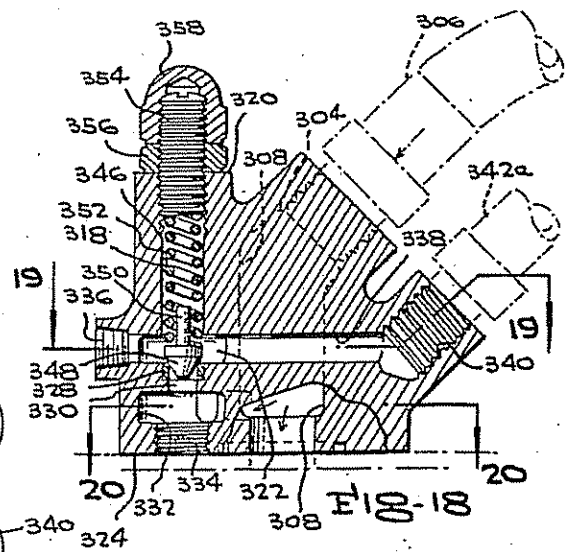


Fig-18

INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 8

FIG-19

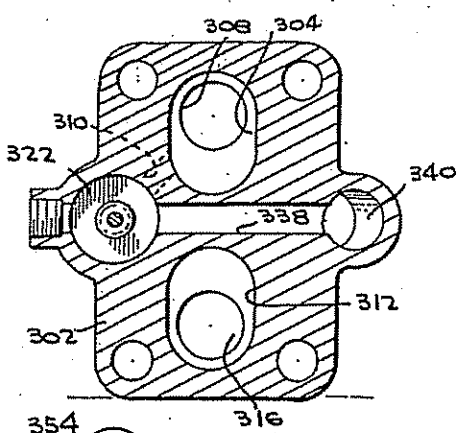
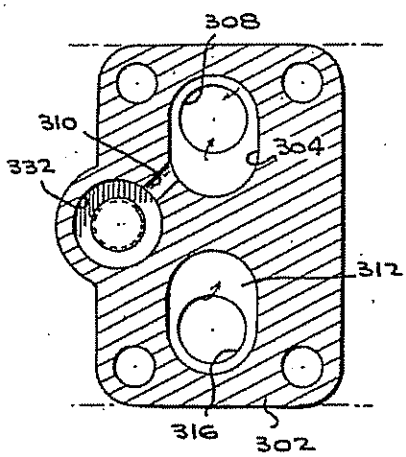


FIG-20



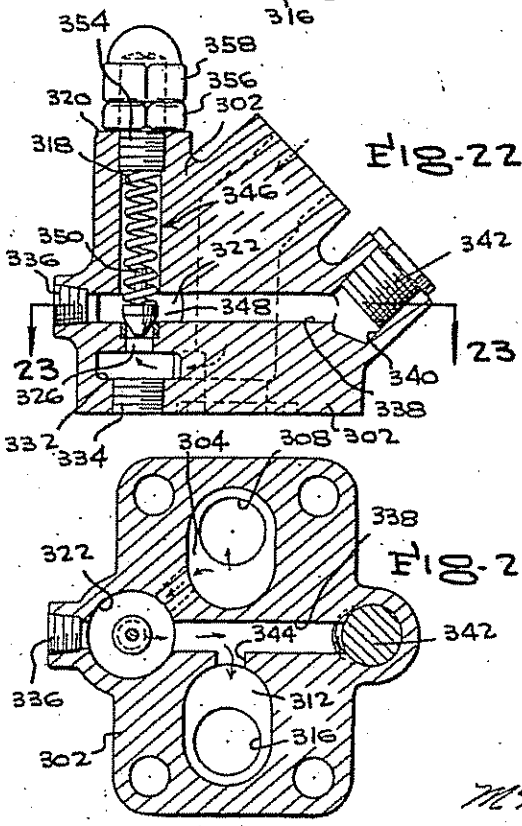
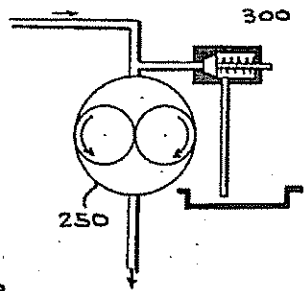


FIG-22

FIG-23

FIG-21



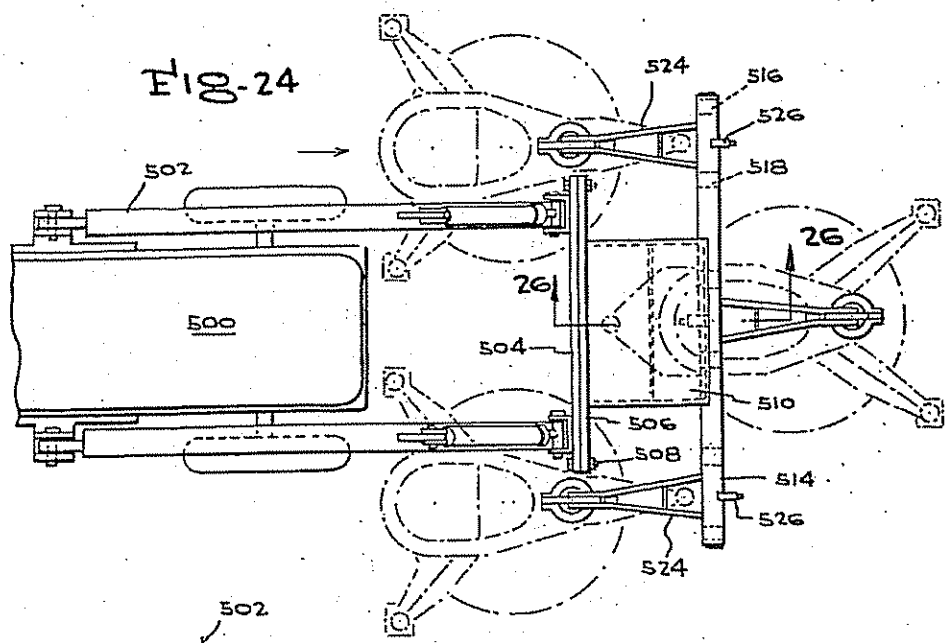
INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

June 2, 1964 T. J. DUNN 3,135,079

MOWING APPARATUS

Filed Aug. 24, 1962 9 Sheets-Sheet 9

Fig-24



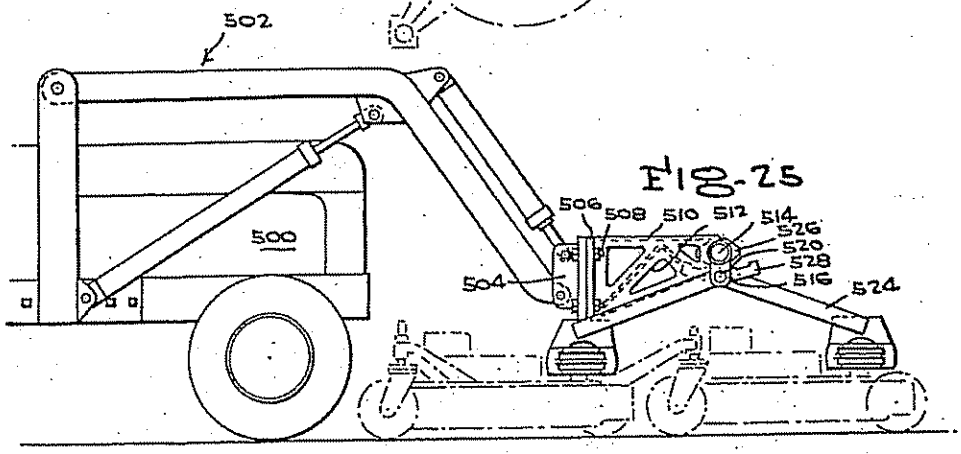


Fig-25

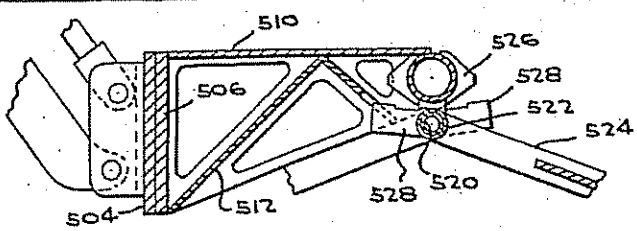


Fig-26

INVENTOR.
THOMAS J. DUNN
BY
McMorrow, Berman & Davidson
ATTORNEYS

United States Patent Office

3,135,079
Patented June 2, 1964

3,135,079

MOWING APPARATUS

Thomas J. Dunn, 600 E. Valley Ave., Hackettstown, N.J.

Filed Aug. 24, 1962, Ser. No. 219,285
9 Claims. (Cl. 56—6)

The present invention relates to mowing apparatus, and more specifically, to mowers having new and novel features particularly adapting the same for heavy-duty operation for sustained periods of time such as is encountered in the mowing of highway divider strips and sidings.

An important primary object of the invention resides in the provision of heavy-duty mowing equipment, embodying one or more cutting assemblies of the rotary type, having features of construction materially reducing accidents resultant from the emission of objects from the housing, and possessing other safety features to protect the operator, other persons or objects adjacent the operating machinery, and the machine per se.

It has been previously known to supply rotary mowers actuated by hydraulic motors. In apparatus used in highway median strips and the like, obstructions of diverse character are often encountered, many times damaging the mowing equipment by reason of the failure of such devices to provide effective by-pass valve means. It is therefore among the objects of this invention to supply an impact valve assembly for use in the hydraulic system of rotary mowing apparatus which is fully effective to prevent damage to the system resultant from the encountering of obstacles by the mower.

Another important objective of the invention concerns the provision of a rotary mowing apparatus adapted for use in gangs or series. It is further within the contemplation of this invention to provide a gang-type rotary mower having terrain adjustment means to prevent "scalping" or to provide for maximum uniformity of depth of cut regardless of the contour of the terrain, said terrain adjustment means operating in universal fashion and about a horizontal axis.

It is another object of the invention to supply a hydraulic mower assembly adapted for towing by a prime mover such as a tractor with a rear mounted hitch; and additionally adapted for pushing by a prime mover having a forward mounted lift mechanism.

Yet another object of this invention centers about the provision of a particular mower housing and cutting blade unit having an inlet means adapted to exclude most non-vegetable matter such as stones, empty cans, and the like, and to harmlessly discharge any such materials which enter the unit against the ground without damage to adjacent persons or objects.

Another object of the invention is to provide a side-mounted, rotary, hydraulically powered mower, incorporating the desirable mower housing-blade arrangement described above.

Among the additional objectives of the invention is the provision of a rotary unit assembly wherein jamming or malfunction of a single unit does not affect the operation of the remaining units in the series.

Other and further objects and advantages of this invention will become apparent to those skilled in the art from a consideration of the following specification when read in conjunction with the annexed drawings, in which:

FIGURE 1 is a top plan view of a first form of mower assembly constructed and assembled in accordance with the teachings of this invention, illustrating an arrangement in which a series of units are towed by a prime mover;

FIGURE 2 is a side elevational view of the assembly of FIGURE 1;

FIGURE 3 is an enlarged, cross-sectional view taken substantially on the section line 3—3 of FIGURE 1, looking in the direction of the arrows;

FIGURE 4 is a bottom plan view taken from the position of the line 4—4 of FIGURE 3, looking in the direction of the arrows;

FIGURE 5 is an enlarged, detail sectional view taken on the line 5—5 of FIGURE 3, looking in the direction of the arrows;

FIGURE 6 is a sectional view substantially on the scale of FIGURE 5, taken on the section line 6—6 of FIGURE 3, looking in the direction of the arrows;

FIGURE 7 is a sectional view of the device taken substantially on the line 7—7 of FIGURE 2, looking in the direction of the arrows;

FIGURE 8 is a diagrammatic top plan view of the assembly of FIGURES 1–7 on a reduced scale, showing movements of the assembly in full and phantom lines;

FIGURE 9 is a side view illustrating movement over uneven terrain;

FIGURE 10 is a rear elevational view illustrating such movement;

FIGURE 11 is a perspective view showing a rotary mower within the scope of this invention in a side mounted location;

FIGURE 12 is a top plan view of the mower of FIGURE 11;

FIGURE 13 is a rear elevational view thereof;

FIGURE 14 is an enlarged, detail cross-sectional view, taken substantially on the section line 14—14 of FIGURE 11, looking in the direction of the arrows;

FIGURE 15 is a detail sectional view along section line 15—15 of FIGURE 14, looking in the direction of the arrows;

FIGURE 16 is a diagramatic view of an hydraulic circuit as used in the form of this invention shown in FIGURES 1–10 and 24–26;

FIGURE 17 is a perspective view of an impact valve mechanism in accordance with this invention;

FIGURE 18 is an enlarged, vertical cross-section, partially broken away, taken substantially along section line 18—18 of FIGURE 17, looking in the direction of the arrows;

FIGURE 19 is a sectional view along section line 19—19 of FIGURE 18, looking in the direction of the arrows;

FIGURE 20 is a sectional view along the section line 20—20 of FIGURE 18, looking in the direction of the arrows;

FIGURE 21 is an hydraulic diagram as employed in the mowing apparatus of FIGURES 11–15;

FIGURE 22 is a view similar to FIGURE 18 of an impact valve, but showing the impact valve as employed in a single mower unit arrangement;

FIGURE 23 is a sectional view along the section line 23—23 of FIGURE 22, looking in the direction of the arrows;

FIGURE 24 is a top plan view of the mower assembly as adapted for pushing forwardly of a prime mover;

FIGURE 25 is an enlarged side elevational view thereof; and

FIGURE 26 is an enlarged, detail sectional view along the line 26—26 of FIGURE 24, looking in the direction of the arrows.

The invention, as shown in the drawings, is adaptable to various mountings on prime movers of a wide variety of types, one example being behind a tractor, as in the towed, multiple arrangement of FIGURES 1–10; a side mounted arrangement of a single mower unit as in FIGURES 11–14 similar to that shown, described, and claimed in prior U.S. Patents Nos. 2,729,044 and 2,840,974; and a novel forward mounting as disclosed in FIGURES 24–26. Adaptation of the assembly to each of these environments requires modifications, discussed in detail below, but each possesses the common features of the impact valve assembly and blade-housing con-

figuration arrangement hereof. Further, each has novel means to maintain maximum uniformity of depth of cut regardless of terrain conditions.

Referring initially to FIGURES 1–10 of the drawings, shown therein is a multiple, gang-type rotary mowing apparatus generally designated by reference character 30. In the disclosed embodiment, three units are illustrated and are adapted for towing by prime mover 32. With specific reference to FIGURES 1, 2, and 8, it will be noted that the prime mover 32 includes a tow hitch assembly 34 capable of being raised and lowered by conventional means including laterally spaced, outwardly divergent braces 36 and 38 attached to the mover 32 at one end. Pivotally secured to each of these braces 36 and 38 are projecting ears 40, 42 of a pivot hitch means 44. The ears 40, 42 are formed integrally or otherwise fixed to leg members 46, 48 which are angled upwardly to converge and terminate in generally vertical, side-by-side end portions 50, 52. A movable control link 54 is extended from the prime mover 32 and pivotally connected at 56 to one end of a pair of arm links 58, 60 secured to the mowing hitch assembly. Also integral with and/or fixed to the ears 40, 42 are a pair of substantially horizontal braces 62, 64 which converge inwardly at their rear ends. As seen in the drawings (FIGURES 1 and 2), both the braces 62, 64 and the arm links 58, 60 are fixed as by welding to an upright, tubular sleeve 66. Intermediate their ends, the arm links 58, 60, pass between the end portions 50 and 52, and a transverse pivot pin 68 or the like is extended therebetween, said pin having a medial spacer portion 70 of enlarged diameter to separate the arm links.

A three point connection means 72 is supplied for furnishing a choice as to longitudinal alignment of the mowing assembly with respect to the prime mover 32. The connection means 72 comprises an elongated, transversely extending generally rectangular body portion 74 having a plurality (in this instance three) of pairs of vertically aligned, horizontal annular bosses 76, 78 arranged along the upper and lower edges thereof on one side. The space between the bosses of each pair is such that the sleeve 66 is insertable therebetween, the opening therein being aligned vertically with the openings in the bosses. In this location, that is, with the openings in substantially vertical alignment, a swivel pin 80 is inserted therethrough whereby the tow hitch assembly 34 is secured to the connection means 72 for lateral swinging movement, as shown in FIGURE 8. If it is desired to limit the swinging movement, the central pair of bosses is used to accommodate the sleeve 66, and additional pins 80 are inserted in the remaining pairs of bosses. Thus, these additional pins will abut against the braces 62, 64 to limit the swinging of the unit.

The opposite side of the body portion 74 along its lower edge has a pair of lateraly spaced rearwardly directed, vertical bosses 82, 84, and an elongated lift arm 86 best seen in FIGURES 1 and 2 extends upwardly and rearwardly from the upper edge thereof. The rearward extent of the lift arm 86 is greater than that of the bosses 82 and 84, the purpose of which appears below.

The connection means 72, in turn, is demountably attached to the mower assembly lift and drag mechanism 88, which includes as its main structural element an elongated transverse tubular hitch bar 90. On the forward side of the bar 90 are located a plurality of projecting, apertured, vertical lugs 92 contained in a group of a length less than the distance between the bosses 82 and 84 and adapted for co-alignment therewith. An elongated pin means 94 is extended therethrough whereby the bar 90 is secured to the connection means 72. On the rear side of the bar 90 are a plurality of pairs of clevises 96—in this case where three units are to be used, two of such pairs 96 being employed—arranged adjacent the outer ends of the bar. Extending between the clevises of each pair 96 is a cylindrical rod 98. Interposed between the pairs of clevises 96, and projecting rearwardly from the bar 90, is an elongated, central bracket frame 100 which may be of any desired form to include an outer cross-member 102 generally parallel to the bar 90. The cross-member 102 has a pair of clevises 104 thereon having rod 106 therebetween similar to clevises 96 and rod 98. Affixed as by welding to the bar 90 at a radius thereof generally perpendicular to the lugs 92 and the pairs of clevises 96 are a pair of L-shaped hangers 108 each having a foot portion 110 fixedly secured along the bar 90 and an upstanding leg portion 112. The leg portion 112 of the hangers are closely spaced and have coaxial apertures therein aligned with an aperture in the lift arm 86 of the connection means 72. A pivot pin 114 is extended through said apertures. Fixing the rod 106 for vertical movement with the rods 98 is an angularly disposed brace element 116 rigidly secured between the leg portions 112 at one end and fixed to the outer cross member 102 of the frame 100 at its other end.

From the foregoing, it will be seen that a hook-up means to a tractor or other prime mover 32 is defined which permits the entire assembly as described hereinbefore to be lifted or lowered. Lifting is accomplished through the conventional action of the hitch assembly 34, but the unit is normaly freely pivotal in a horizontal plane about the vertical swivel pin 80.

The multiple arrangement of FIGURES 1–10 includes three rotary mowers 118, 120 and 122 arranged in series, and mounted for overlapping in cutting area, the mowers 118 and 122, the outer units, being identical to one another, and hence, a single description is applicable to both. The central unit 120 is quite similar differing only in its wheel arrangement, as will appear below, and only the differences will be described to avoid repetition.

Referring to FIGURES 1, 3 and 4, it will be seen that the mower units 118 and 122 each comprises a housing 124 having a generally discoidal, flat top deck 126 having a substantially rectangular rear extension 128. An annular, depending side wall 130 extends about the circular portion of the periphery of the deck 126, and includes a leading portion or entrance portion 132 and a trailing portion 134 which is of greater depth than said entrance portion. Angularly mounted, rigidifying plates 136 project outwardly from the side wall 130 at the junctions of said entrance and trailing portions on each side of the housing. A discharge housing 138 is fixed to the main housing, and includes a top wall 140 secured to the rear extension 128 of the housing deck, side walls 142, 144, and an outwardly and downwardly flared rear wall 146.

The deck 126 has a central opening 148 formed therein, and a tubular blade rotation means collar 150 is fixed as by welding to depend into the housing about said opening. A generally rectangular forward divider plate 152 is welded in the interior of the mower housing forwardly of the rotation means collar 150, and a rear divider plate 154 is fixed in the housing diametrically opposite thereto. The plate 154 has a shallow forward portion 156 and a deep rear portion 158 and extends across the main housing fully to but not including the discharge housing 138. The shape of the rear divider plate 154 is for coaction with the mower blade, as described in more detail below.

Fixed to the upper side of the deck 126 is a flat, generally elongated wheel mounting plate 160 which is tapered from its rear portion 162 toward its forward portion 164. On the opposite sides of the forward portion 164 are fixed a pair of wheel mounting brackets 166 (which are also welded to the deck 126) which extend upwardly and outwardly and terminate in horizontal portions 168 generally parallel to the plate 160, the brackets and their horizontal portions having upwardly projecting, strengthening flanges along their side edges. The rear portion 162 of the plate 160 extends over the discharge housing 138,

and an upwardly and outwardly extending wheel mounting bracket 170, terminating in horizontal portion 172, is fixed thereto. Thus, as seen in FIGURES 1 and 4, each mower unit 118 and 122 has a pair of forward wheel brackets 166 and a trailing wheel bracket 170. The respective horizontal portions 168 and 172 each has secured thereto a sleeve 174 having a boss 176 on one side thereof, the boss having a threaded, horizontal aperture formed therein receiving a set screw 178. Through each sleeve 174 is extended a substantially cylindrical, vertical spindle 180 having a plurality of recesses 182 arranged in a vertical column on one side to receive the inner end of the set screw 178. The spindle 180 is fixed to a castor wheel assembly 184. As seen in FIGURE 3, the arrangement is such that selective height adjustment of the mower housing is provided by the selection of location of the set screw 178 in the recesses 182 of the spindles 180.

The intermediate mower unit 120 is identical in construction and assembly to the outer units 118 and 122, except that a forward wheel mounting bracket 186 extends from the forward portion 164 of the plate 160 thereof, and a pair of side wheel mounting brackets 188 and 190 extend outwardly and rearwardly from an intermediate location along said plate 160. The brackets 186, 188 and 190 each carry a sleeve and castor wheel assembly as previously described.

As will appear below in the description of operation, the multi-unit arrangement of FIGURES 1–10 is adapted for automatic terrain adjustment to maintain maximum uniformity of depth of cut, even over relatively uneven ground. This is accomplished, in large part, by the provision of novel means 192 for connection of the individual mower units 118, 120, 122 to the lift and drag mechanism 88. The means 192 (the same for all units) include a two-piece trunnion 194 journaled about the rod 98 or 106. Trunnions 194 comprise threaded, telescoping sleeves to take up end play between clevises 96 or 104. Fixed to each trunnion 194 are a pair of connector arms 196, 198 which are rearwardly converging and permanently joined by a spacer plate 200. A vertical tubular standard 202 is fixed to each unit as by welding adjacent the forward edge of the portion 162 of the plate 160 and has a pair of horizontal openings in diametrically opposite sides thereof through which is received a locking pin 204. This pin 204 also passes through openings in a ball means 206 having a vertical bore 208 therein to receive the standard 202. Bore 208 is open at its upper end to permit welds 210 permanently securing it in place on said standard. In FIGURES 3 and 5, it is seen that the pin 204 includes end portions extending outwardly on each side of the ball 206. Socket means 212 for receiving the ball 206 comprises a pair of elements 214, 214 each having a spherically curved portion 216 and vertical flanges 218, 220 apertured to receive a plurality of bolt and nut connections 222. In order to fit the elements 214 about the ball 206, and yet to provide limiting guideways for the pin 204 the spherically curved portions are of less than semi-spherical shape, and vertically arcuate spacer blocks 224, also apertured for the connections 222, position same together about the balls. These spacer blocks are formed as integral, depending fingers on an upstanding connection block 226 which is secured between the connector arms 196 and 198. Thus, as illustrated in FIGURES 6, 9 and 10, each unit is mounted for limited rocking movement as dictated by terrain around either a longitudinal or transverse axis, but is restrained from any rotary movement around a vertical axis.

FIGURES 9 and 10 illustrate the manner in which the multiple unit adapts to the cutting of non-level terrain, the individual units acting in response to the contour of the terrain. Thus, scalping or uneven cutting is positively prevented.

Each unit 118, 120 and 122 is provided with a blade 228 which includes a substantially rectangular central portion 230 having a plurality of connection apertures therein. On each side of the central portion is an outwardly and downwardly angled part 232, 234, said angled parts being oppositely inclined in their angular planes. Integral with each angled part are outer cutting parts 236, 238, respectively, which are inclined upwardly from front to rear (that is, in the direction of cut) and offset forwardly from the plane of the central portion 230. Viewed from the side as in FIGURE 3, it is seen that the upper outline shape of the blade 228 conforms with the shape of the lower edges of the divider plate 154. The inclinations of the various portions of the blade are such that, when the blade is rotated rapidly as occurs in use, an upward current of air is formed propeller fashion tending to draw vegetable matter upwardly into the forward portion of the mower housing. Also, a rotary current of air is effected above the blade whereby material severed by the blade is moved in the direction of rotation until it reaches the divider plate 154. Upon impingement on said plate the severed material is exhausted outwardly and downwardly through the discharge opening. Any non-vegetable matter, such as cans, broken glass, or the like, is expelled harmlessly against the ground by reason of the shape of said exhaust housing.

The drive unit for the blade 228 comprises a shaft 240 having a depending cross piece 242 to which the central portion of the blade is fixed by bolt means. The shaft is mounted in a bearing sleeve 244 and keyed to a multiple pulley wheel 246 about said bearing sleeve above the deck 126. A suitable cover 248 is provided on the deck to prevent fouling by foreign matter. A conventional fluid drive motor 250 is provided and is mounted above a cover 252 for a drive pulley wheel 254. The drive shaft 256 of the fluid motor extends into said cover and is secured to wheel 254. Belts 258 are trained about the pulley wheels 246 and 254 and transmit rotary movement therebetween.

In each form of this invention, a novel impact valve arrangement is employed which positively prevents damage to the cutting machinery or its drive even if a foreign object suddenly stops the operation of the blade. The valve is generally designated by reference character 300. The construction of the valve 300 includes a substantially solid valve body 302 having an inlet opening 304 threaded to receive a fluid supply hose 306 carrying fluid from a pump source 301 shown schematically in FIGURE 16. The inlet opening 304 is inclined from the horizontal and is in communication with a vertical inlet passageway 308 leading into the fluid motor 250. As shown in FIGURE 20, an emergency horizontal by-pass channel 310 extends from one side of the opening 304 to a chamber 332. The valve body 302 also has an inclined outlet opening 312 for attachent of outlet hose 314, the opening 312 communicating with a vertical relief passageway 316 for the motor 250.

In order to provide for the by-passing of a jammed motor, the body 302 has an elongated vertical opening 318 (FIGURES 18 and 22) therein extending from the top 320 of the body and opening into a circular chamber 322 intermediate the top 320 and bottom 324 thereof. Chamber 322 occupies a horizontal plane above the channel 310. Beneath the chamber 322 and coaxial therewith is a valve seat opening 326 into which is fitted a seat 328, and the opening 326 communicates with a short opening 330 leading to the second chamber 332 in the same horizontal plane as the channel 310. A plug 334 seals the chamber 332 at its bottom and provides for necessary access for cleaning or repair. Plug 336 provides such ccess to the chamber 322.

A transverse relief passageway 338 extends through the body 302, opening on the chamber 322 at one end, and on an inclined chamber 340 at its other end. Chamber 340 is either plugged at 342 as in FIGURE 22, or provided with a hose 342a leading to a by-pass reservoir as shown in dotted view in FIGURE 18, depending upon whether used in a series arrangement (FIGURE 16)

or alone (FIGURE 21). In any event, there is provided a passage 344 between the passageway 338 and the outlet opening 312.

A valve nipple assembly 346 is provided and assumes the position shown in FIGURES 18 and 22. Assembly 346 includes nipple element 348 which rests on the seat 328, an extension 350, a coil spring 352 urging the nipple 348 against the seat 328, and tension adjustment screw 354 threadedly engaging the opening 318. Lock nut 356 and cap nut 358 complete the tension adjustment and retaining means for the nipple assembly 346.

In normal functioning, the flow is merely into the opening 304, through the passageway 308 and thence into the motor 250. Return flow is through the relief passageway 316, the outlet opening 312 and thence to the next motor or the reservoir. However, should motor 250 be forceably halted or prevented from turning, for example, by material being jammed between the blade and the bottom edge of divider plate 154, pressure build-up in the passageway 308 and channel 310 is transmitted through the chamber 332 through the short opening 330 thereby raising the nipple 348 from its seat and permitting fluid to enter the chambr 322 from which it is vented through the transverse passageway 338 either through the passage 344 (FIGURE 23) and out the opening 312, or through the passageway 338 and out a hose 342*a* (FIGURE 18). In either case, damage to the motor 250 is prevented, and in multiple arrangements, the operation of the remaining upstream units in a series is unaffected by stoppage of any one or more thereof, as will be seen in FIGURE 16.

A single, side mounted unit of mowing apparatus is illustrated in FIGURES 11–15 inclusive, and employs a mount somewhat similar to that shown in the prior U.S. patents mentioned above, Nos. 2,729,044 and 2,840,974.

The side mounted unit, generally designated by reference numeral 400 includes a mower unit 402 identical with the units 118, 120 and 122 previously described, in all respects except for the wheel mount arrangement. In the case of the unit 402, a forward wheel mounting arm 404 including arms 406, 408 is secured by welding to the upper side of the housing deck, and a rear wheel unit 410 extends from the wheel mounting plate 164.

In FIGURES 12 and 13, the tractor side frame is identified by reference numeral 412. Bolted or otherwise fixed to the frame 412 is a control and mounting frame 414 carrying control handles 416 on its upper end, and having depending ears 418 with an axle 420 journaled therebetween. A sleeve 422 is rotatably mounted on the axle 420 and has an outward link 424 welded thereto. The sleeve link 424 has a pair of side-by-side connection ears 426, 428 fixed to its outer end, and an upstanding limit lug 430 to prevent upward rotation past a predetermined point. Depending from one of the ears 418 and fixed thereto is a bracket 432 to which is fixed one end of an extensible hydraulic cylinder 434. The other end of cylinder 434 is pivotally connected to a bracket 436 on the link 424. Thus, it will be seen that rotational movement of the sleeve 422 about the axle 420 is controlled by extension and retraction of said cylinder 434. One of the handles 416 is the control for said cylinder.

The ears 428 and 426 are connected by a pin 437 pivotally to an upstanding element 438 of a break-away hinge assembly 440, as described in said prior patents. The hinge 440 has an inwardly depending link piece 442 secured pivotally to one end of a second hydraulic cylinder 444—the other end of which is fixed to the frame 414 whereby extension thereof pivots the hinge 440 vertically about the pin 437.

As seen from the foregoing, the entire unit is raised by actuation of the cylinder 434, and the hinge and its associated parts tilted with respect to the frame 414 by actuation of the cylinder 444.

The hinge 440 (FIGURE 14) includes an outwardly projecting arm 446 having a rebent outer end 448 which terminates in a sleeve 450. Sleeve carries pin 452 and a plate 453 depends from said arm.

Means for connection of the break-away hinge 440 to the mower unit 402 includes a connection assembly 454 having a plurality of arms 456, 458 and 460 welded to the mower deck. The arms are interconnected at one end by a base plate 462. Arising from the base plate 462 between the arms 456 and 458 is a swivel plate 464 having an arcuate slot 466 which receives the pin 452. As shown in FIGURE 14, this permits limited movement around the axis of an axle 472 of the assembly 454 relative to the arm 446 and plate 453. FIGURE 15 illustrates the further connection of the assembly 454 to the hinge 440, including a pair of spaced apart lugs 468, 470 extending upwardly from plate 462 between the arms 458 and 460 and supporting the axle 472 therebetween. A sleeve 474 fixed to a bracket 476 comprising a fixed extension on the hinge 440 receives the axle 472, and thereby completes this connection.

Thus, the unit 402 may be raised and lowered from the ground, may be pivoted horizontally about the break-away hinge, or may be tilted for a mowing operation in other than in horizontal position.

In FIGURES 24–26, the means for forward mounting of a multiple arrangement of cutting units is shown. The units per se are those described above in reference to FIGURES 1–10, and hence, only the mount is shown in full lines in the former figures and hereinafter described.

The prime mover 500 has a conventional boom and lift 502 terminating in a transverse forward plate 504. An elongated, generally rectangular push plate 506 is detachably secured to the plate 504 along the full length thereof, as by bolts 508. A rectangular extension plate 510 is fixed centrally to the plate 506, and includes depending, rigidifying brace means 512. Fixed to the forward end of the plate 510 and its brace 512 is an elongated transverse tubular push bar 514, having a plurality of pairs of depending lugs 516, 518, each having an axle 520 therebetween. These axles 520 are passed through sleeves 522 on the proximal ends of mower connection arms 524 extended thereto from each of the mower units (preferably arranged as shown in FIGURE 24).

Since the sleeves 522 are rotatable on the axles 520, to provide for pivotal mounting of the arms with respect to the bar 514, and in view of the fact that it is desired to utilize the lift arrangement of the prime mover to remove the units from terrain contact for movement from one location to another, rotation limit means are provided. Such means comprise substantially triangular stop lugs 526 welded to the bar 514 on the side thereof opposite the main direction of extension of the connection arms 524. Coacting wth the stop lugs 526, are aligned extensions 528 projecting outwardly from the appropriate side of each sleeve 520. These sleeve extensions abut the stop lugs 526 as the sleeves rotate, thereby effectively limiting rotational movement.

Having described and illustrated the various embodiments of the invention, wherein each embodiment employs a mower housing and blade arrangement having the desired objectives set forth above, and an impact valve arrangement positively preventing damage to the unit resulting from forceable stoppage of a blade, it will be understood that these descriptions and illustrations are offered merely by way of example, and that the invention is to be limited only by the scope of the appended claims.

What is claimed is:

1. A rotary mower comprising a mower housing including an upper deck, a depending peripheral wall secured to said deck, said peripheral wall having a discharge opening therein, respective forward and rear depending longitudinally extending vertical divider plates in said housing secured to said upper deck, a blade rotatably mounted in the housing below and closely adjacent the divider plates, means for rotating the blade, said

divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, and a discharge housing secured to the mower housing around said discharge opening, said discharge housing having a rear wall and side walls arranged such that all discharge therefrom is directed downwardly against the ground.

2. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extending adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith; a hydraulic motor mounted on the housing, said motor having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

3. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extending adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, said blade having an inclined outer propeller portion producing an upward air current responsive to rotation of the blade, said air current tending to draw material upwardly into the forward portion of the mower housing and to move the material in the direction of rotation of the blade and to blow the material against said rear divider plate, the material being exhausted rearwardly through the discharge opening, a hydraulic motor mounted on the housing, said motor having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

4. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extendibng adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a downwardly and outwardly directed discharge housing secured to said mower housing in communication with said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, a hydraulic motor mounted on the housing, said mower having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

5. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extending adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a downwardly and outwardly directed discharge housing secured to said mower housing in communication with said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, said blade having an inclined outer propeller portion producing an upward air current responsive to rotation of the blade, said air current tending to draw material upwardly into the forward portion of the mower housing and to move the material in the direction of rotation of the blade and to blow the material against said rear divider plate, the material being exhausted rearwardly through said discharge opening, a hydraulic motor mounted on the housing, said motor having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

6. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extending adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, said blade having downwardly offset inclined outer propeller portions producing an upward air current responsive to rotation of the blade, said rear divider plate being increased in height adjacent said discharge opening so that its bottom edge contour conforms generally with the offset shape of the blade, said air current tending to draw material upwardly into the forward portion of the mower housing and to move the material in the direction of rotation of the blade and to project the material against the rear divider plate and blow the material through said discharge opening, a hydraulic motor mounted on the housing, said motor having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

7. A rotary mower comprising a mower housing including an upper deck and having a depending peripheral wall provided with a discharge opening, diametrically longitudinally extending front and rear vertical divider plates in said housing secured to and depending from said upper deck, said rear divider plate extending adjacent said discharge opening and being spaced from said peripheral wall opposite said discharge opening, a downwardly and outwardly directed discharge housing secured to said mower housing in communication with said discharge opening, a blade rotatably mounted in the housing below and closely adjacent said divider plates, said divider plates extending on opposite sides of the axis of rotation of said blade and being in the same plane therewith, said blade having downwardly offset inclined outer propeller portions producing an upward air current responsive to rotation of the blade, said rear divider plate being increased in height adjacent said discharge opening so that its bottom edge contour conforms generally with the offset shape of the blade, said air current tending to draw material upwardly into the forward portion of the mower housing and to move the material in the direction of rotation of the blade and to project the material against the rear divider plate and blow the material through said discharge opening, a hydraulic motor mounted on the housing, said motor having fluid inlet and outlet conduit means, means drivingly connecting said motor to said blade, and hydraulic fluid supply conduit means connected to said inlet conduit means.

8. A mowing apparatus comprising a plurality of mowing units, means to connect said mowing units to a common prime mover, each mowing unit comprising a mower

housing including an upper deck, a depending peripheral wall secured to said deck, said wall having a discharge opening therein, a blade rotatably mounted in said mower housing, a longitudinally extending vertical divider plate in said mower housing secured to and depending from said upper deck, the bottom edge of the divider plate extending closely adjacent the path of movement of said blade, said divider plate being in the plane of the axis of rotation of the blade and terminating adjacent said discharge opening, a hydraulic motor mounted on said housing, means drivingly connecting said motor to said blade, a single hydraulic pump, conduit means connecting the hydraulic motors in series to said pump, whereby to circulate hydraulic fluid through the motors, respective normally closed by-pass valves connected across the hydraulic motors, and means opening the valves responsive to the building up of fluid pressure at the input sides of the motors caused by restraint against rotation of the blades, whereby to allow the hydraulic fluid to by-pass the motors.

9. Mowing apparatus including a plurality of rotary mowers, means to connect the mowers to a prime mover, each mower comprising a mower housing, longitudinally extending divider means in the housing, a blade rotatably mounted in the housing adjacent the divider means, the divider means extending on opposite sides of the axis of

rotation of the blade, means for rotating the blades, including at least one hydraulic motor having an input side, a discharge housing secured to the mower housing, having walls arranged such that all discharge therefrom is directed downwardly against the ground, means drivingly connecting the motor to the blade of each mower, a single hydraulic pump, conduit means connecting the pump in series with the motor of each mower to circulate hydraulic fluid through the motors, a normally closed relief valve connected acros a portion of the conduit means including at least one of the motors, and means opening the valve responsive to fluid pressure build-up on the input side of the one motor.

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James

[11] **4,308,713**

[45] **Jan. 5, 1982**

[54] **HYDRAULICALLY DRIVEN MOWER**

[75] Inventor: Ronald N. James, Seguin, Tex.

[73] Assignee: Terrain King Corporation, Seguin, Tex.

[21] Appl. No.: 144,312

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[51] Int. Cl.³ A01D 69/00; A01D 73/00; A01D 55/264

[52] U.S. Cl. 56/11.9; 56/6

[58] Field of Search 56/6, 11.9, 13.4; 165/179, 181, 177

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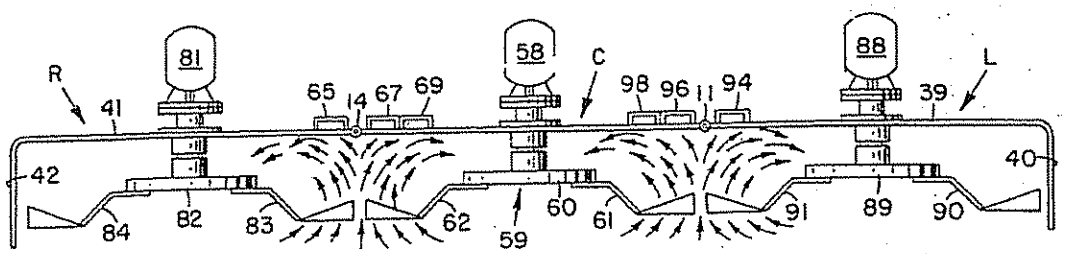
Primary Examiner—Paul J. Hirsch

Attorney, Agent, or Firm—Cox & Smith Incorporated

[57] **ABSTRACT**

A hydraulically driven mower having a mower deck with conduit means in contact with the deck for flowing hydraulic fluid which powers hydraulic motors for driving cutting blade means positioned below the mower deck so that air flow created by the cutting blade means will provide heat transfer from the hydraulic fluid in the fluid conduit means through the deck member to provide cooling of the hydraulic fluid and a hydraulic drive system having a pressure relief means to direct hydraulic fluid supplied to a first hydraulic motor in series to the next hydraulic motor in series when the first hydraulic motor overloads to maintain sufficient hydraulic power to the second motor.

7 Claims, 4 Drawing Figures



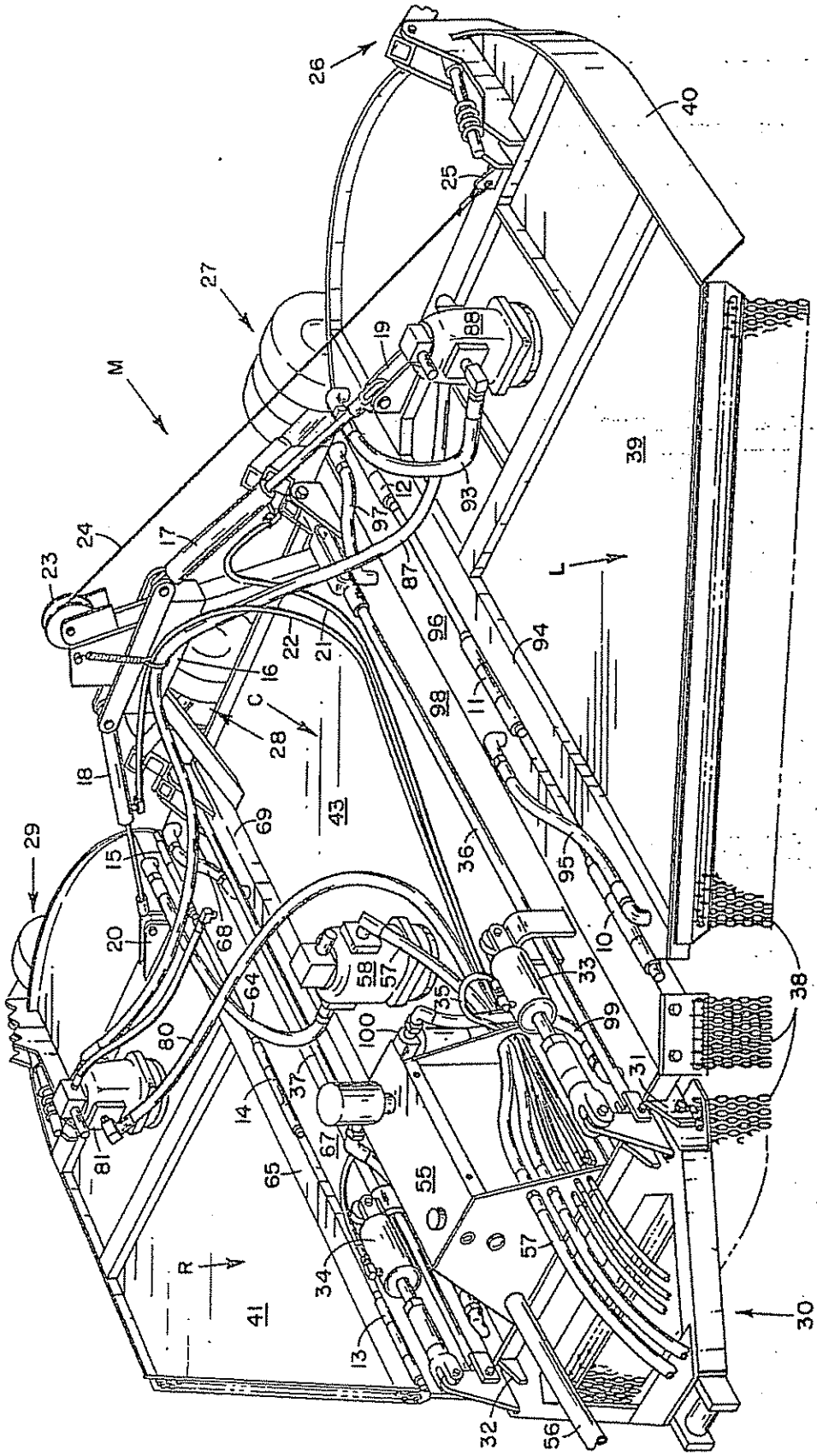

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FIG. 1

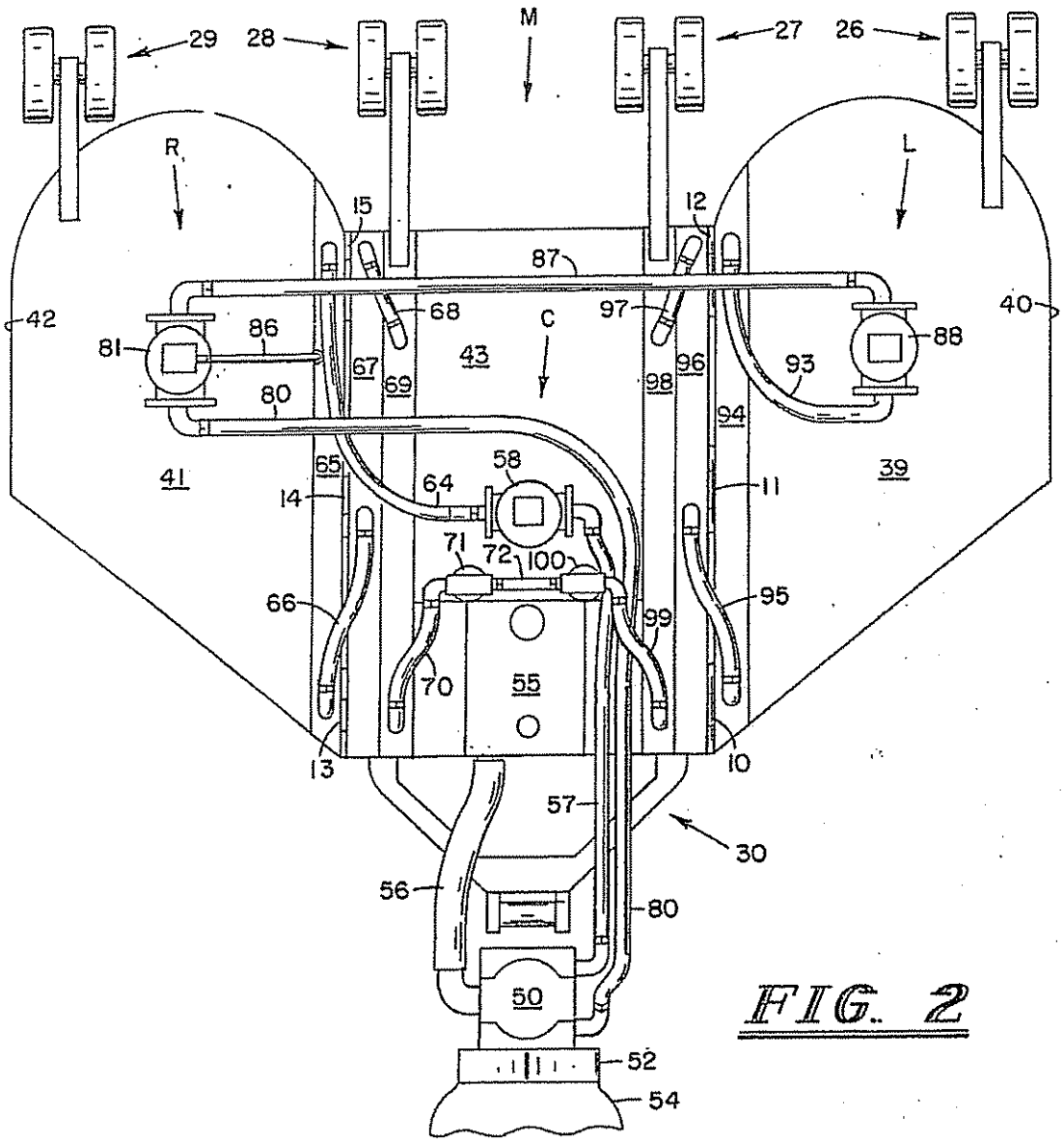
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FIG. 2

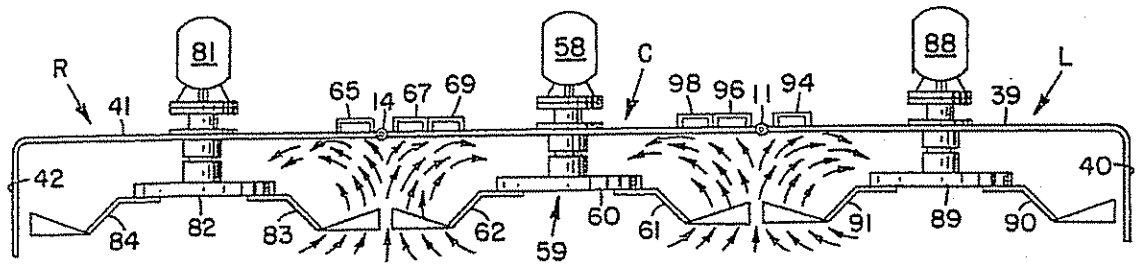
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FIG. 3